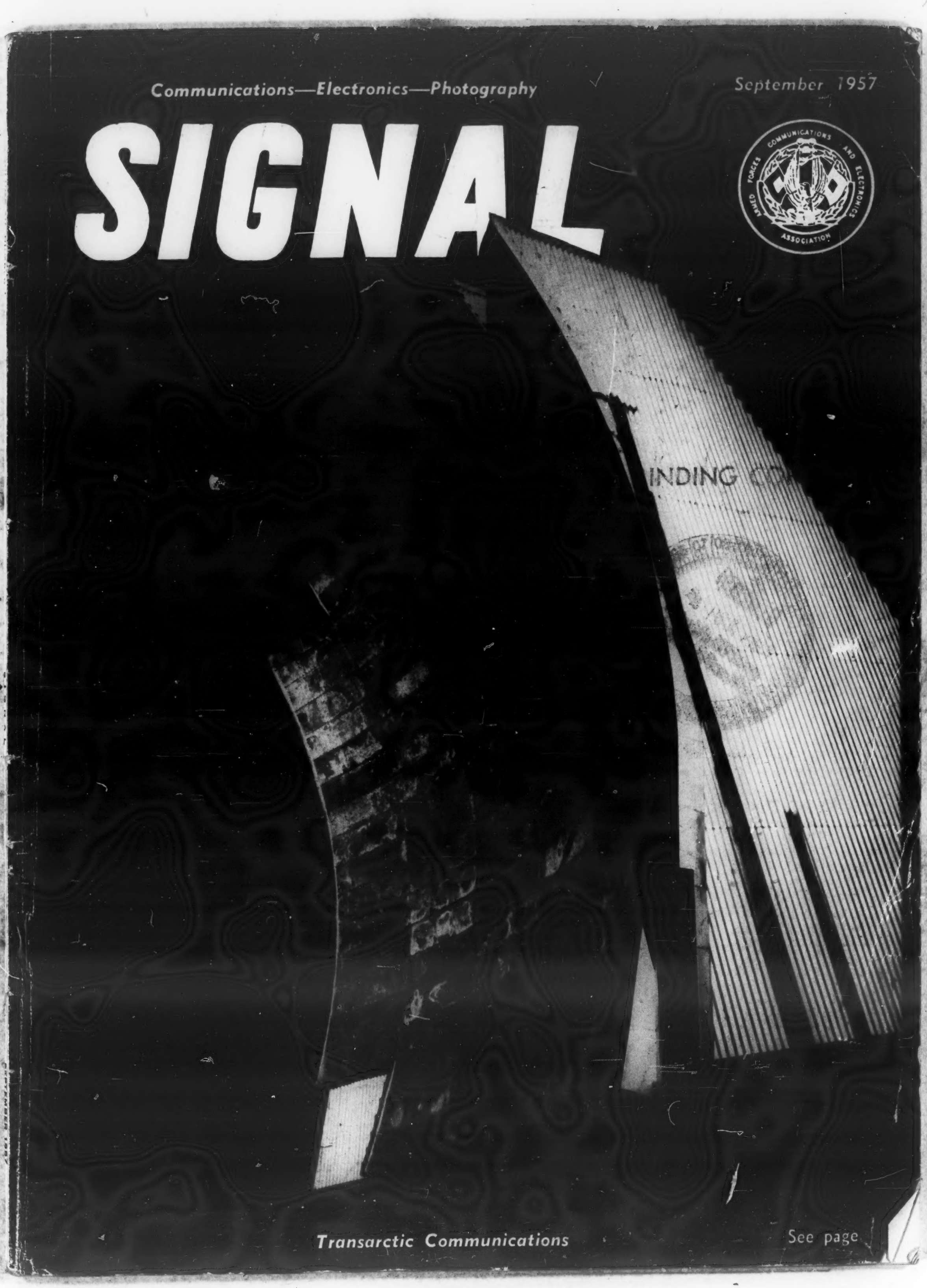
Communications—Electronics—Photography

September 1957

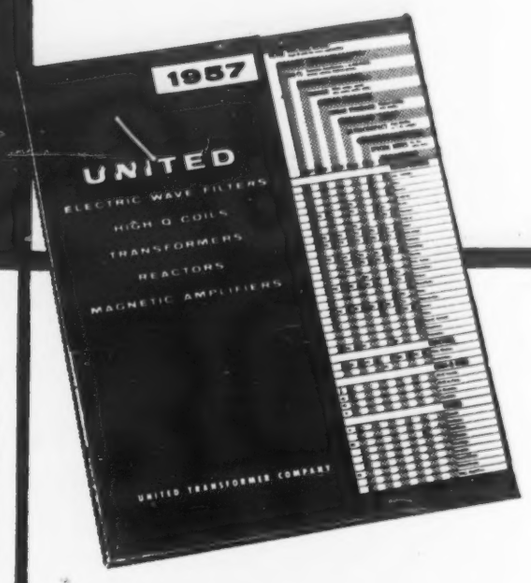
SIGNAL

ARMED FORCES COMMUNICATIONS AND ELECTRONICS ASSOCIATION



Transarctic Communications

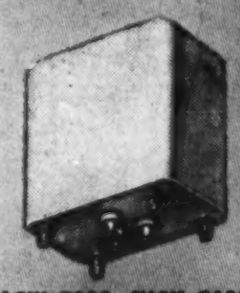
See page

..FROM STOCK

VARIABLE INDUCTORS
Standard,
Hermetic MIL-T-27A

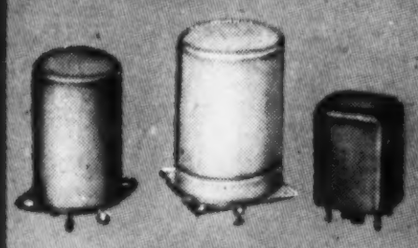
LOW FREQUENCY INDUCTORS
INDUCTANCE DECADES

PERMALLOY DUST TOROIDS
Hermetic, MIL-T-27A
Highest Q, accuracy and stability

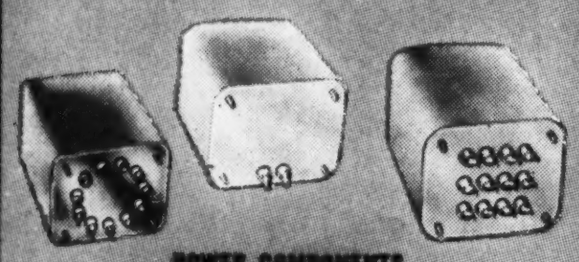
Write for your Copy of Latest Catalog.



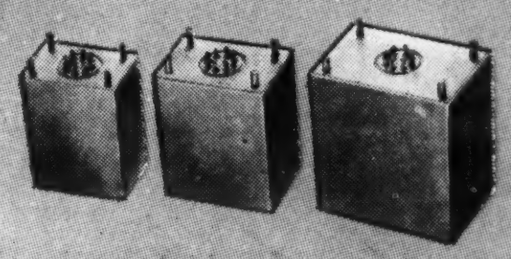
LOW PASS, HIGH PASS, BAND PASS FILTERS
Hermetic, MIL-T-27A



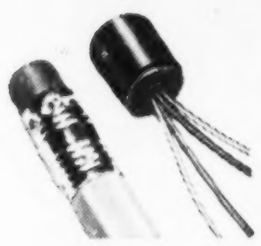
AUDIO COMPONENTS
Hermetic, MIL-T-27A
for every application



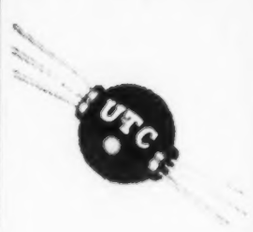
POWER COMPONENTS
Hermetic, MIL-T-27A
Power, Plate, Filament Transformers,
Filter chokes



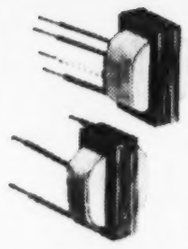
MAGNETIC AMPLIFIERS
Hermetic, MIL-T-27A



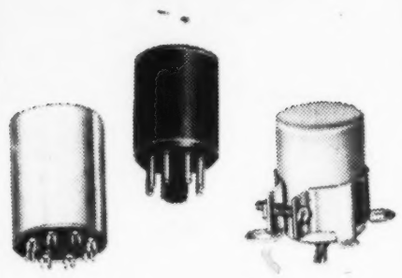
DECI-OUNCER
Transistor transformers .1 oz.
Hermetic, MIL-T-27A



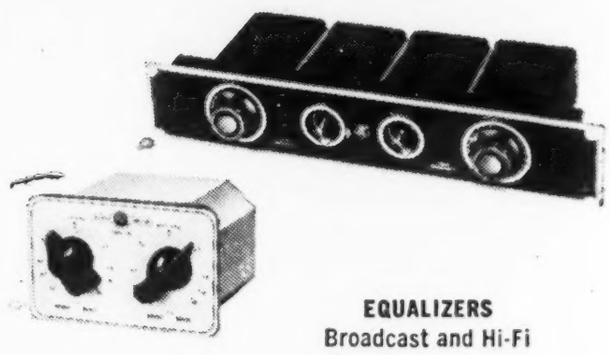
PULSE TRANSFORMERS
Wound Cord, MIL-T-27A



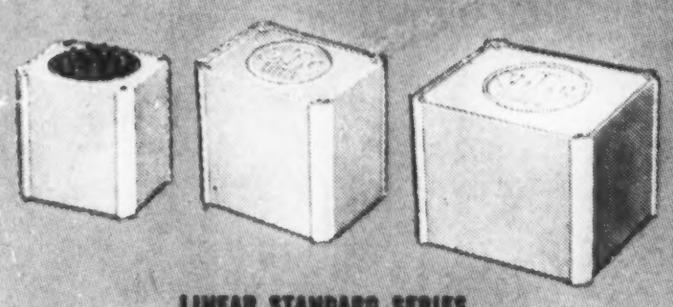
SUB and SUB-SUB OUNCER TRANSFORMERS
Audio and
Transistor



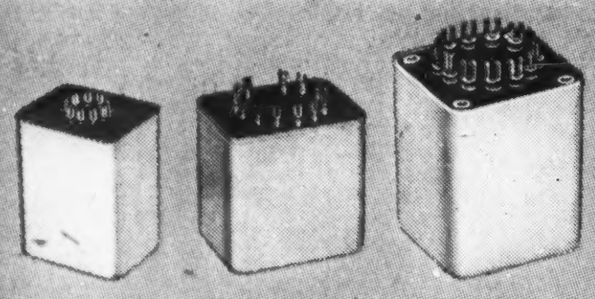
OUNCER AND PLUG-IN
Wide Range Audios



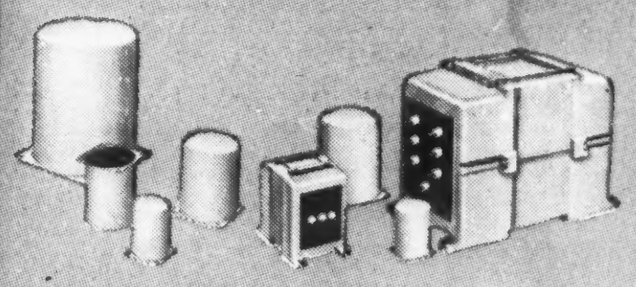
EQUALIZERS
Broadcast and Hi-Fi



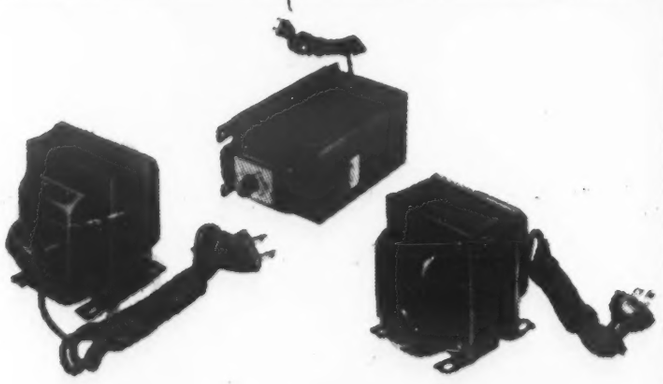
LINEAR STANDARD SERIES
Highest Fidelity Audio Units



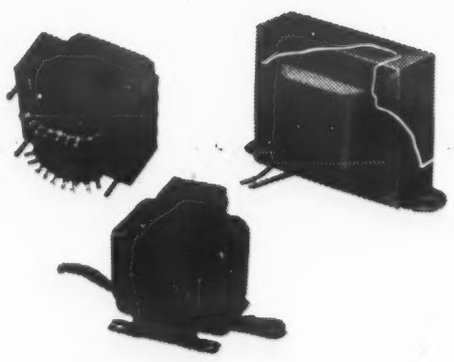
HIPERMALLOY AND ULTRA COMPACT
Broadcast and Hi-Fi Favorites



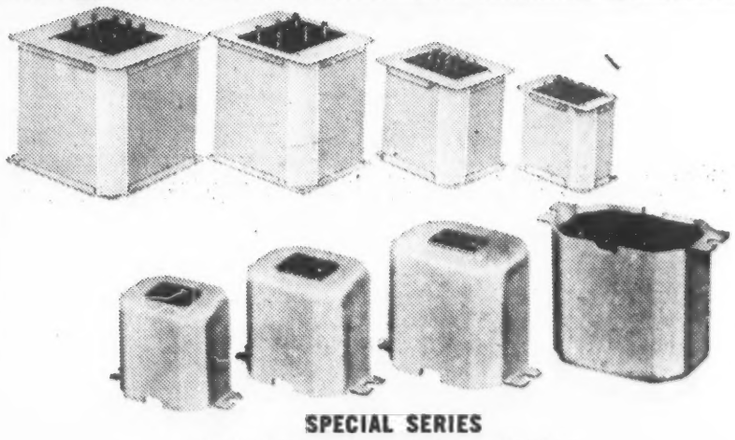
COMMERCIAL GRADE
Power and audio units for industrial service



VOLTAGE ADJUSTORS . . . STEPDOWN and ISOLATION TRANSFORMERS



REPLACEMENT TYPES



SPECIAL SERIES
Units for every amateur application.

Bell Telephone Laboratories, Murray Hill, N. J.

DREAMS WITH A PURPOSE

"Leave the beaten track occasionally and dive into the woods. You will be certain to find something you have never seen before."

ALEXANDER GRAHAM BELL

THERE have always been dreams and high hopes in the communications business. And always, for something over eighty years, there has been continuous and determined research to help make those dreams come true.

For before there was a telephone there was a telephone laboratory.

First it was just two men, Bell and Watson, in an attic workshop. Then the idea grew, as the need grew, and the practical values of research became more and more apparent.

Today there are more than 10,000 people at Bell Telephone Laboratories, of whom over 3000 are trained scientists and engineers.

Their work covers many fields and goes exploring and developing in many directions. But everything is directed to one goal. It is the betterment of communications service and the finding of ways to provide this better service at the lowest cost to the customer.

The great assets of the Bell Laboratories are the judgment and knowledge that have been gained from years of experience, combined with the enthusiasm of minds versed in the newest scientific knowledge.

There is also the encouragement of initiative through a careful balance of pure research and developmental work. The scientist is given a freedom that is rare in industrial work.

Some of the great achievements of the Bell Laboratories have come in recent years.

The Transistor is a Bell Telephone Laboratories invention. So is the Solar Battery. So, too, are the switching machines that have brought about Direct Distance Dialing. And, again, there was the development of those wonderful amplifiers for the underseas telephone cables.

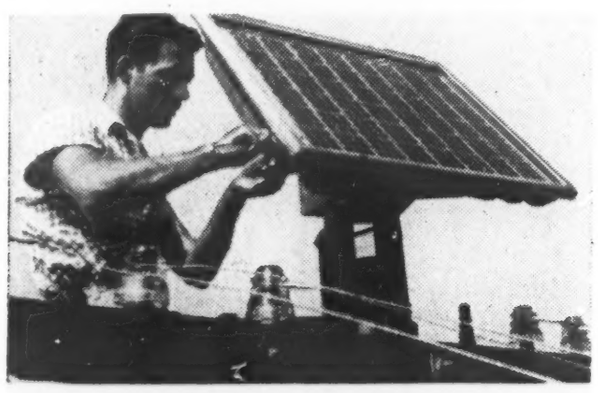
It all adds up to a great deal of progress. But there is much more to come. All that has been done is but the beginning.

Never have there been so many opportunities for wholly new developments in telephone service and so much well-rounded research behind them.

Each day there are excursions off the beaten path, revealing something that has never been seen before.

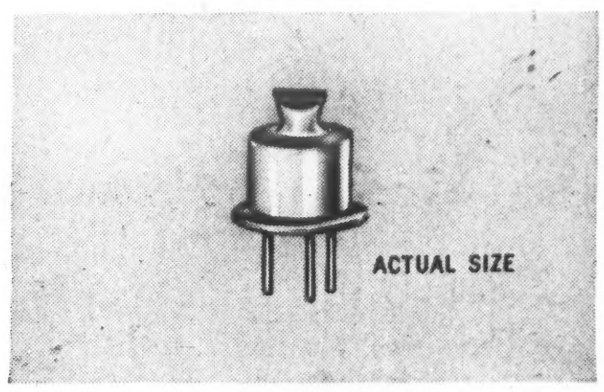
Working together to bring people together

BELL TELEPHONE SYSTEM



BELL SOLAR BATTERY

Converts sun's rays into usable amounts of electricity by means of specially treated discs of silicon. Has been used experimentally to power rural telephone lines.



THE TRANSISTOR

One of the break-throughs in science that come only at rare intervals. This mighty mite can do many of the things that an electronic tube can do and more besides!

DIRECT DISTANCE DIALING

By the end of this year some 5,300,000 telephone customers in 440 localities will be able to dial directly to as many as 35,000,000 telephones all around the country.

COMMUNICATIONS -- *Half the Battle!*

Will today's communications help win tomorrow's battles? For a good answer, take a look at how the U. S. Army Signal Corps is keeping ahead of the fast-changing techniques of military operations — by providing *tomorrow's* communications systems *today*.

Look, for example, at the Signal Corps' completely miniaturized, all-transistor carrier system for cable or microwave communication in the field. It is fully portable, takes up less than a cubic foot of space, weighs only 65 pounds (compared to 500 for comparable World War II equipment). It provides 4 separate channels, offers highly reliable operation under severe conditions ranging from Arctic cold to tropic sun.

Lenkurt, selected as prime contractor for the development of this carrier, has facilities uniquely oriented to research, development, and precision production for vital defense projects. As a leading specialist in telecommunications, Lenkurt works directly with government agencies and with other manufacturers in providing equipment either "off-the-shelf" or specially designed, to meet the highest standards and most exacting requirements of the military.

For complete information, write Dept. 9-A, 1105 Old County Rd., San Carlos, California

Lenkurt ELECTRIC

San Carlos, Calif. • Mexico, D.F. • Vancouver, B.C.

1624 Eye Street, NW
Washington 6, D. C.
Phone: EXecutive 3-3033

Editor
W. J. BAIRD

Advisory Editor
ROLAND C. DAVIES

Managing Editor
JUDITH H. SHREVE

Chapter News Editor
JULIA B. GODFREY

Associate Editors
CHARLES DeVORE
GEORGE C. RUEHL, Jr.
DR. HAROLD A. ZAHL

Contributing Editors

Army
LT. COL. KENNETH E. SHIFLET, SigC.

Navy
CAPTAIN J. S. DORSEY, USN

Air Force
MAJ. JAMES H. MABRY, USAF

Photo News
FRANK SMITH

SIGNAL is published monthly by the Armed Forces Communications and Electronics Association at 1624 Eye St., N. W., Washington 6, D. C. Entered as Second-class matter at Post Office, Washington, D. C., September 6, 1946, under Act of March 3, 1879. Additional entry at Baltimore, Maryland.

Subscription rate to members of the AFCEA: 1 year (12 issues), $5.00. To non-members, $6.00. To foreign post offices, $6.50. Single copies, $1.00 each.

All rights reserved. Copyright 1957 by Armed Forces Communications and Electronics Association. Reproduction in whole or in part prohibited except by permission of the publisher.

Printed in U.S.A. by Monumental Printing Co. at Baltimore, Md. The publisher assumes no responsibility for return of unsolicited manuscripts or art. When sending change of address, please list the old and the new address, and allow 3 weeks for delivery of first copy.

BPA

SIGNAL

Communications-Electronics-Photography

Journal of the Armed Forces Communications and Electronics Association

VOLUME XII | SEPTEMBER 1957 | NUMBER 1

CONTENTS

Features

The President's Page 5
Frederick R. Furth

The White Alice Story 7
William E. Burke

Golden Era 11
Don G. Mitchell

Electronic Production-Performance-Engineering 16
Lt. Gen. C. S. Irvine, USAF

A Tribute to A Leader 19
Editorial Staff

Bizmac 24
Arthur L. Malcarney

Balloons in the Civil War 26
Col. H. V. Canan, USA (Ret.)

The Third Link 30
Editorial Staff

Vanguard Instrumentation System 33
Vernon J. Crouse

Rapid Fault Elimination in Complex Electronic Systems 38
John F. Scully

Scatter Propagation, Part II 42
Col. Robert C. Sears, USAF

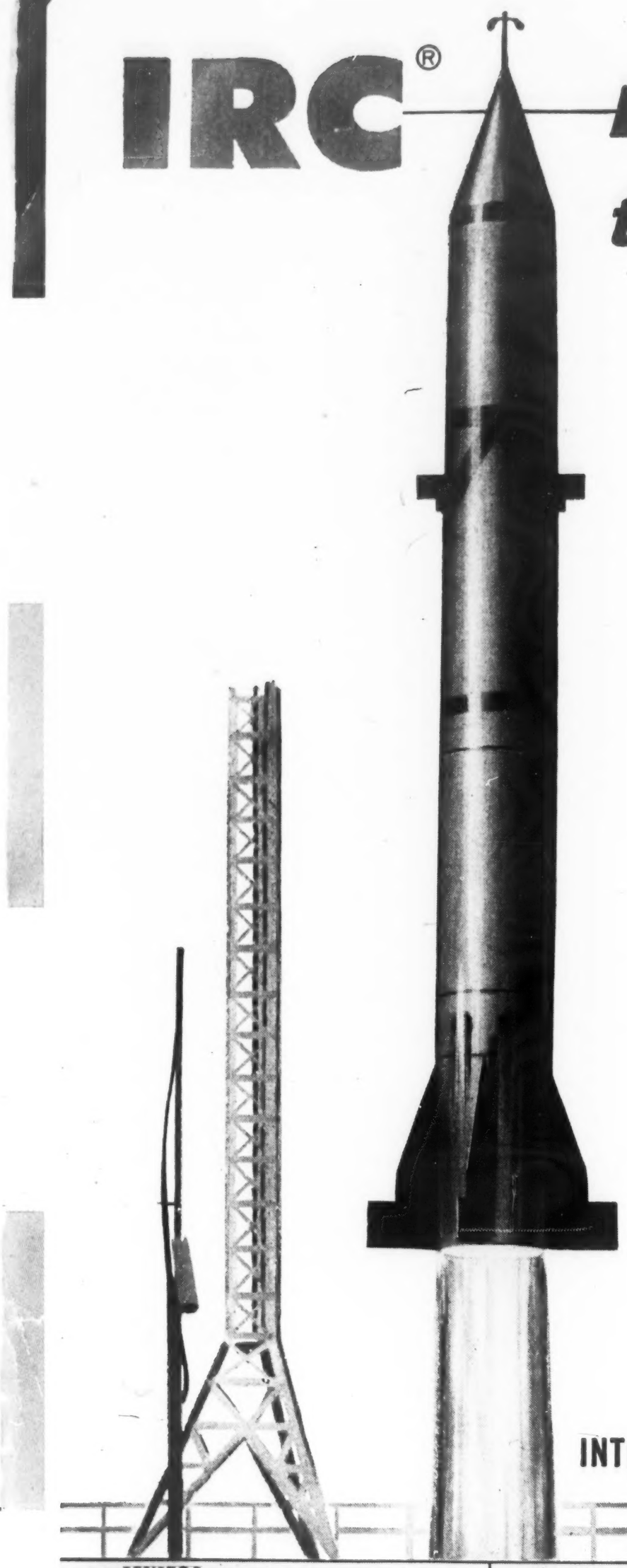
Photoprogress 46
Frank Smith

DEPARTMENTS

Signalgram 21
Association Affairs 52
AFCEA—R.O.T.C. Awards 53
AFCEA Group Members Directory 56
AFCEA Chapters and Chapter Officers Directory 58
Chapter News 60
Items of Interest 65
Personnel Clearing House 72
New Products 74
Books 79
Index to Advertisers 80

Authors are entirely responsible for opinions expressed in articles appearing in AFCEA publications, and these opinions are not to be construed as official or reflecting the views of the Armed Forces Communications and Electronics Association.

IRC® BREAKS THROUGH
the reliability barrier



As jet planes and missiles leave old barriers behind, electronic components find ever-tougher barriers of reliability ahead of them. Those designed for yesterday are already obsolete, those designed for today will soon be. But IRC resistors are ready now to leap ahead of tomorrow's new barriers. Designed ahead of their time, they are also produced by "ahead of their time" processes and quality control techniques. This pattern of progress makes IRC reliability a standard unto itself—a standard that is yours on the widest range of electronic components in the industry.

There is nothing theoretical about the IRC standard of reliability. In most of the major avionic progress-projects, it is being proved out by rigorous field tests. It is also apparent in the way IRC resistors withstand extreme temperature, humidity, and mechanical conditions. It is evident, too, in resistance to shock and vibration . . . in improved shelf life . . . in the way IRC resistors consistently surpass MIL spec requirements.

IRC

INTERNATIONAL RESISTANCE CO. Dept. 545, 401 N. Broad St., Phila. 8, Pa.

RESISTOR	IRC TYPE	MIL TYPE	MIL SPEC.	WRITE FOR IRC BULLET
Fixed Composition	BT	RC	MIL-R-11B	B-1
Fixed Wire Wound (Low power)	BW	RU	JAN-R-184	B-5
Fixed Wire Wound (High power)	PWW	RW	MIL-R-26C	C-1
Fixed Wire Wound (Precision)	516L 316A	RB17 RB52	MIL-R-93A MIL-R-93A	PH
Meter Multiplier (Sealed precision)	MF	MF	JAN-R-29	D-2
Deposited Carbon	DC	RN	MIL-R-10509B	B-4
Deposited Carbon (Molded)	MD	RN	MIL-R-10509B	B-9
Boron Carbon	BC	RN	MIL-R-10509B	B-6
Boron Carbon (Molded)	MB	RN	MIL-R-10509B	B-8
High Frequency	MP HFR	RF RF50	MIL-R-10683A MIL-R-10683A	F-1

COMPUTER COMPONENTS

Pressure Transducers
Digital Logic Elements
Packaged Custom Networks
Differential Transformers
Integrators
Static Switches
Magnetic Amplifiers
Shift Registers

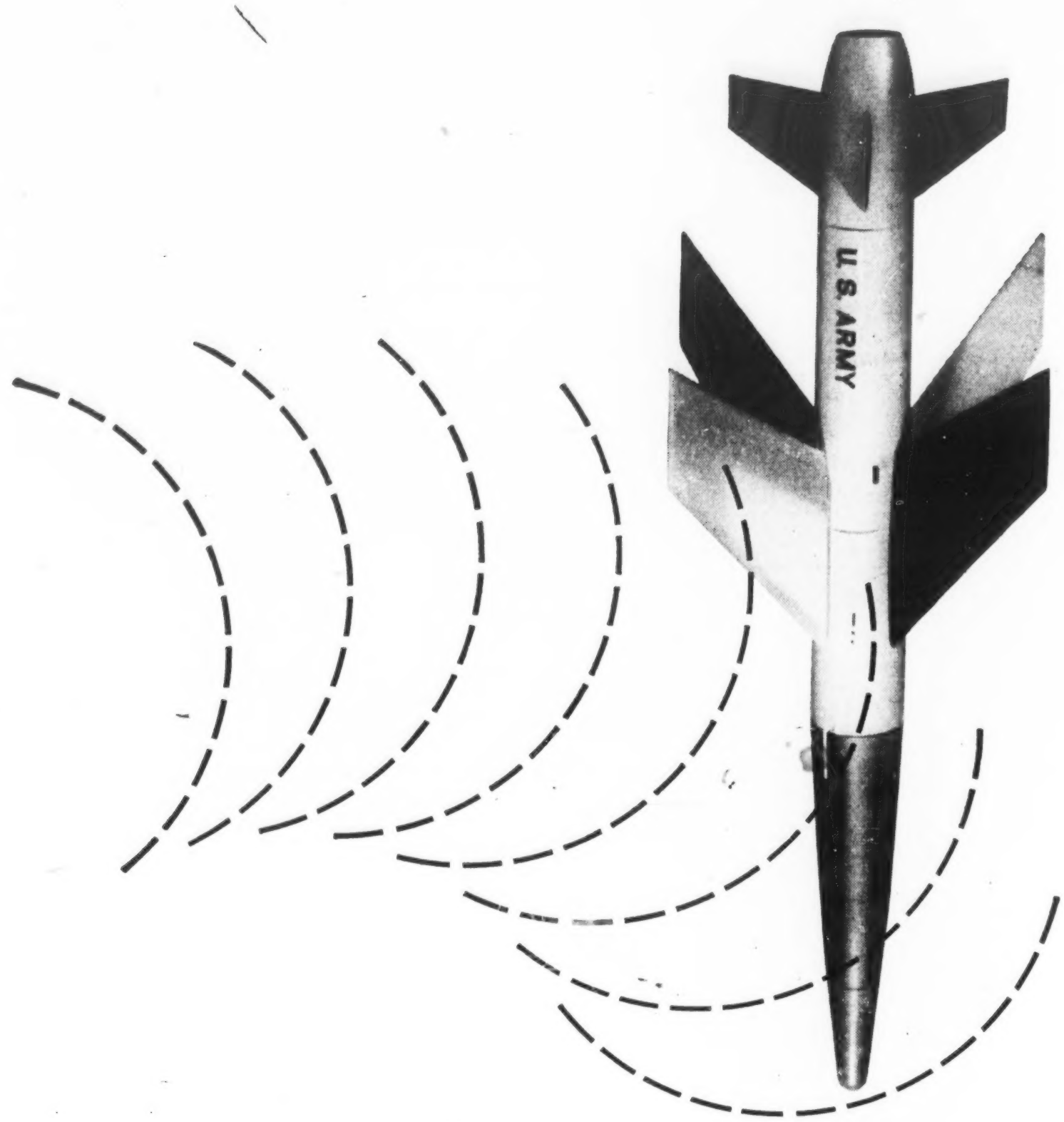
The President's Page

Frederick R. Furth

In my first message, I wish to express my profound appreciation for the honor which you have conferred upon me as President of AFCEA for the year May 1957-May 1958. I am fully aware of the importance and responsibilities of this office and the obligations that such an honor demands on behalf of the Officers, Executive Committee, the Board of Directors and the Chapter Officers. There are but few positions which are as meaningful as that of the Presidency of the Armed Forces Communications and Electronics Association.

AFCEA is truly an association of dedicated individuals who comprise the civilian-military team concept. In our work in the communications and electronics field we must be continuously alert to the problem of balancing the heavy requirement for a strong military posture against the needs of a viable, expanding national economy. I mention this for it is imperative that we discuss such an issue as well as other major problems at our chapter meetings and, at the same time, follow closely the timely articles published in SIGNAL Magazine. By so doing, we keep ourselves abreast of events which affect our national growth and security. It seems to me that this is one way we can actively stimulate progressive interest in our chapter activities. In order to further stimulate chapter interest, Captain Wilfred B. Goulett, USN, Ret., has been named executive vice-president. His duties, among others, will be that of maintaining close contact between National Headquarters, our chapters and group members.

Finally, I would like to call upon our chapter presidents and group members to assist in building up membership in AFCEA. Last year our membership showed a steady increase. This was due in no small way to the issuance of an improved monthly magazine instead of a bi-monthly publication. I am sure there are many individuals who would like to know more about the Armed Forces Communications and Electronics Association and who would be interested in joining if they were extended an invitation.



NEW WEAPON, NEW CONCEPT

An important new weapon for a new U. S. Army concept is now being delivered in quantity by Martin-Orlando. This is LACROSSE, a field artillery guided missile, developed to implement the combat concept of the Pentomic Army...a "fighting" Army consisting of self-sufficient highly mobile battle groups. LACROSSE will provide these battle groups with the shockpower of extraordinary speed, mobility and accuracy in heavy armament support of their operations. LACROSSE is the first generation of an entirely new kind of general purpose weapon. All of its components, consisting of the missile mounted on a standard Army truck and a guidance system, can be airlifted to advance areas. The missile is fired in the general direction of the target—without target data at the launching site. Its pinpoint accuracy is controlled by a forward observer. The Martin Company, with more than 10 years of design, production and operational experience in guided missiles, today stands as a leader in this important field.

MARTIN

BALTIMORE DENVER ORLANDO

the WHITE ALICE story

by William E. Burke

Vice President

Defense Projects Division

Western Electric Company

STATION BY STATION THE LINKS IN a vast new communications system are being forged in Alaska. Known by the Air Force code name as "White Alice," this system will connect remote key locations to major defense and population centers. Built primarily for defense communications purposes under a contract with the Western Electric Company, White Alice will undertake an additional civic duty, providing telephone and telegraph circuits for public use over a rugged land that has often been described as America's last frontier.

It utilizes those seven league boots of modern communication, microwaves and over-the-horizon tropospheric scatter radio systems to provide reliable transmission.

By late summer, 13 stations were in service furnishing about 1,000 route miles of circuits. By Spring of next year, the presently planned system of 33 stations covering over 3,000 route miles will be completed.

This remarkable long-haul communications network has its origin in the problems of the geography of Alaska itself. A look at a map will show that the territory lies in the direct path of air routes over the top of the world—a logical direction from which hostile air attacks could be launched against the United States.

Defense installations have multiplied in Alaska in recent years. Radar stations, Air Forces bases, Army and Navy installations and most recently the Distant Early Warning Line have been established, taking advantage of Alaska's position as an outpost of the Nation from which her first defense against an attack could be mounted.

Study of Needs

As this defense complex grew, the need for a modern, reliable communications network within the territory to support military operations became imperative. The requirements dictated that these facilities not only interconnect military establishments in Alaska, but tie them into the continental communications network as well.

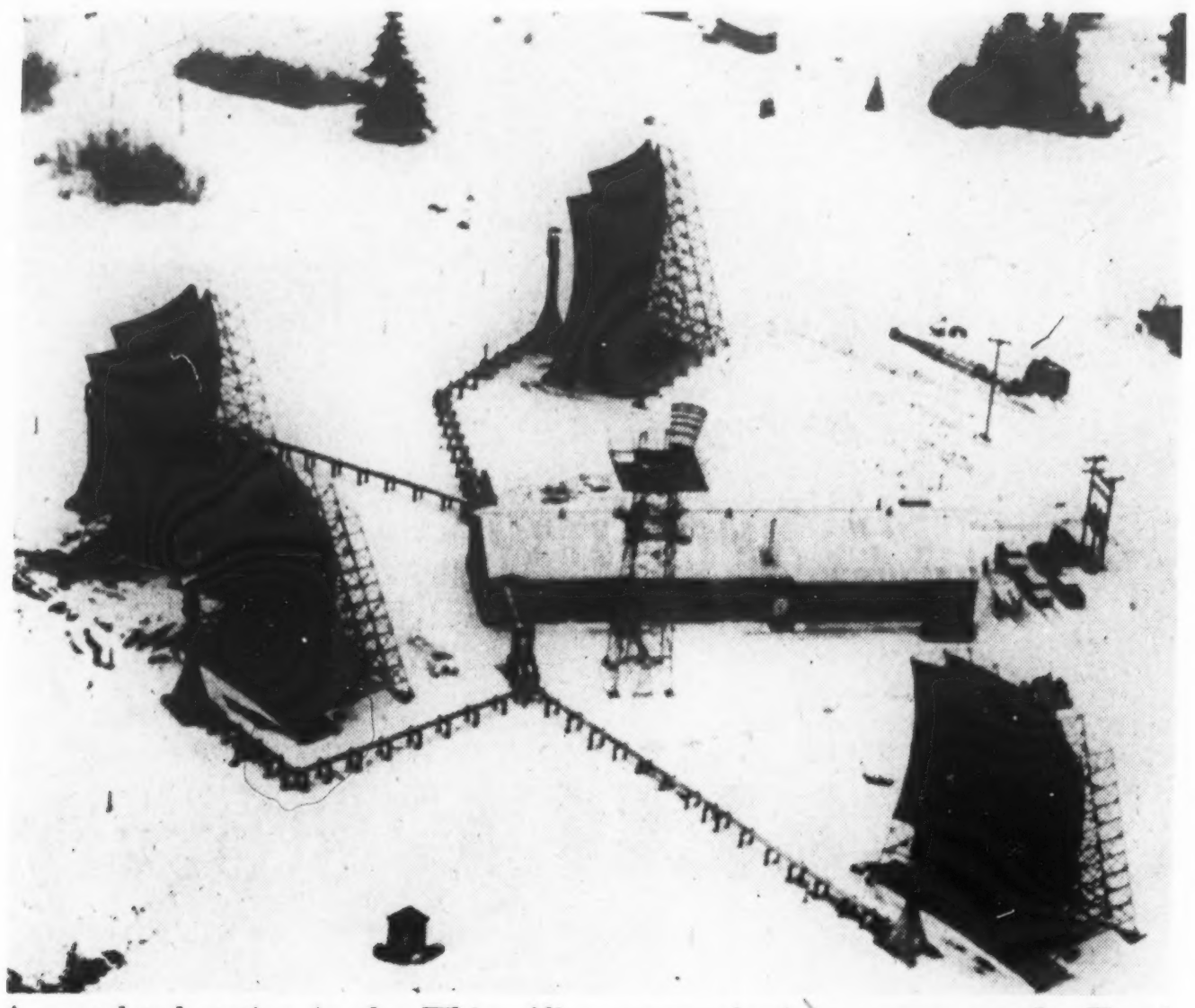
Prior to the advent of the White Alice System, Alaska not only faced communication problems typical to an undeveloped and sparsely settled frontier, but it also had to contend with mountainous topography, extreme weather conditions and the variable radio propagation conditions of the Arctic and subarctic. The long distance wire network connecting the main populated areas of Fairbanks and Anchorage is operated by the Alaska Communication System (Signal Corps) under most difficult conditions. High frequency radio circuits operated by the Air Force, Civil Aeronautics Authority and ACS to remote areas have limited channel capacity and are subject to poor propagation conditions.

The growing requirements for improved service prompted the Air Force, in 1954, to request the American Telephone and Telegraph Company to undertake a comprehensive study of communication needs. This work was undertaken by the Long Lines Department.

The task was to provide a plan for an integrated communication system of a large number of channels equal in quality and reliability to Bell System long-haul circuits and designed first to provide essential defense needs for the Air Force and, secondly, to serve the requirements of all other government agencies where advantageous. These included military installations, air traffic and weather networks operated by the CAA and civilian services furnished by Alaska Communication System (Signal Corps).

Together, the weather and the topography ruled out conventional telephone and telegraph networks of cable and extensive microwave systems. Construction costs would be excessive and access for maintenance impossible.

This study showed that standard Bell System TD-2 Microwave systems operating in the 4,000 megacycle band with repeater spacings of about 30 miles could be used in built-up areas adjacent to main roads when line of sight could be achieved,



A completed station in the White Alice communications system on the Kenai Peninsula interconnecting two tropospheric scatter paths and one microwave radio relay path.

and the unattended repeater stations would be accessible for year round maintenance. Thus, the section near Anchorage from Wasilla through Anchorage and extending down the Kenai Peninsula to Homer involved 8 links and 178 route miles of these microwave facilities and was easily solved.

The remaining links of over-water and over-mountain hops of considerable distance dictated the use of the newest technique of radio communication, Forward Propagation Tropospheric Scatter. This UHF system operating in the 700-900 megacycle band employs high power transmitters and very large parabolic antennas to span up to 170 miles between stations. Thus stations could be located for the most part near points of circuit usage and minimize the number of stations to be built. Further, both microwave and tropospheric scatter systems can, by proper engineering of paths, provide freedom from the high intensity electrical disturbances and radio blackouts that have traditionally rendered Arctic radio communications useless for long periods.

Over-the-Horizon Technique

The system now authorized and resulting from these recommendations consists of 33 stations covering about 3,000 route miles of which 23 links use the over-the-horizon technique. Locations of stations were determined by considering the terminal point of the circuits to be provided, the location of users, and a study of available topographic maps. Either one KW or ten KW transmitters built by Radio Engineering Laboratories, Inc., feed 30 foot circular parabolic or 60 foot rectangular parabolic antennas, depending on the path loss. Up to 132 voice channels are derived on either the TD-2 or scatter links using Western Electric Type K and L frequency division multi-channel terminal equipment. Telegraph channels are obtained by adding Western Electric 42A1 voice frequency carrier telegraph terminals to the voice channels. In total there are 170,000 telephone channel miles and 50,000 telegraph channel miles furnished by the system.

Authorization to proceed with the design and construction of the system was given to the Western Electric Company's Defense Projects Division in January 1955. The system requirements included not only the basic electronic facilities but buildings, fuel oil storage, water supplies, and in many instances, dormitories, access roads and some airstrips. In addition, varying requirements for entrance facilities required placing of substantial amounts of cable and the use of short distance radio links to connect users to the system.

Many defense installations to be served were not located for ease of access. Further, the characteristics of the scatter system requiring zero or negative angle takeoff and unobstructed horizon for propagation, dictated that most sites had to be located on mountains or high ground. These latter requirements increased tremendously the construction costs and logistics problems. Site locations, weather and terrain (and even a few bears) joined to create difficult construction conditions.

Construction responsibility of the buildings and related facilities for 10 of the sites was placed on the United States Army Corps of Engineers. On the remaining 23 sites this was included in the Western Electric contract which subcontracted this work to a number of firms, with Morrison and Knudson having a majority of the work.

Tests and Construction

Western Electric's job of design, engineering, construction supervision and test started with basic development supervision from the Bell Telephone Laboratories. The project team was organized from personnel obtained from many companies of the Bell System, each individual a specialist in some phase of the work.

Before construction could start, field survey teams explored the ground. They found that the best maps showed mountains sometimes as much as ten miles out of place and errors in elevation of as much as 1,000 feet. They also checked the construction possibilities of the tentative locations. Even then, the stations could not be built until radio propagation tests verified calculations and showed that satisfactory transmission was possible.

Transmission path testing required the temporary installation of test transmitters and receivers, and the erection of antenna towers up to 200 feet tall. Often 14 tons of equipment were moved to mountain tops by airlift in planes and Air Force helicopters. Hazardous landings were made on treacherous stretches of snow in planes equipped with skis. At times the crews had to put much of the equipment on their backs and hike.

After test gear was set up, a vigil of several weeks of propagation recording began. The crews had to continuously operate their sensitive measuring equipment while snow, driven on the Arctic winds, lashed their canvas shelters. Storms twice blew down and destroyed the well-anchored test antennas.

When construction work began, the airplane, often called the covered

(*Continued on page* 10)

PORTABLE RADAR STATIONS MEASURE AND DOUBLE CHECK 50 MILE READINGS IN SECONDS

For the *first time*, surveyors are freed from short-sighted optical equipment. Unlike old-fashioned surveying tools, the "radar ruler" pierces through fog, darkness or dense foliage, electronically pacing off distances of 1 to 50 miles, precise to within a few meters!

This new general-purpose surveying instrument was developed by Motorola's Military Electronics Laboratory for the Signal Corps Engineering Laboratories, Fort Monmouth, N. J. The entire operation can be handled easily and quickly by unskilled personnel.

This self-calibrating system uses two identical portable radar stations which bounce a signal back and forth thousands of times each second. High-speed computers automatically provide the data necessary to measure off the distance.

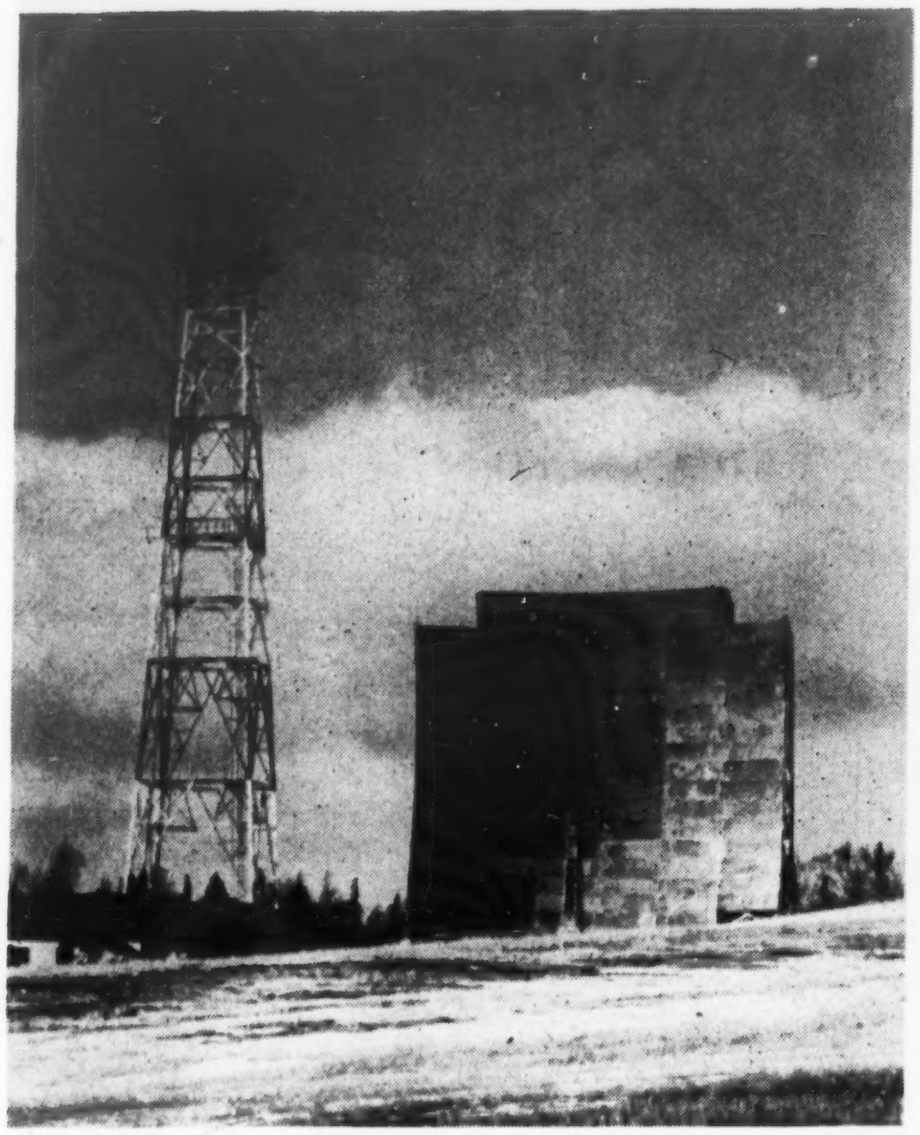
Here is just one more example of the equipment now being developed by Motorola for many varied military applications.

3 suitcases and a 25 ft. collapsible antenna comprise the entire equipment

navigational devices • radar • countermeasures • microwave systems • communications equipment
data transmission • plotting systems • telemetering • data processing and presentation indicators

Positions open to qualified Engineers and Physicists

MOTOROLA *Communications & Electronics Division*
National Defense Department
2710 N. Clybourn Ave., Chicago, Ill. Other facilities: Phoenix, Arizona and Riverside, California



Completed station (above left) in Matanuska Valley area interconnecting tropospheric scatter path and microwave radio path. Scatter station (above right) interconnects three paths with two antennas for each path. Two paths require 60 ft. rectangular parabolic antennas, and one uses a 30 ft. circular parabolic antenna.

wagon of the Arctic, became the work horse of White Alice. Charter craft, piloted by the famed bush pilots and Air Force planes with their seasoned crews delivered men, equipment, and materials to remote wilderness locations. Frequently weather and landing conditions were unknown until the pilot was within a few miles of his destination.

Sea and land transportation were used when possible. However, the Bering Sea is usually open to shipping only about five months each year. The White Alice station at Cape Lisburne on the Arctic Ocean is icebound ten months a year! Even during open periods, storms and fog peril shipping operations. At every point in the Bering Sea area, except one, cargo was lightered ashore. Often the barges were lashed to Caterpillar Tractors while being unloaded to prevent their being wrecked by rough seas. In all, a total of over 70,000 tons of material and supplies have been delivered to White Alice sites in Alaska.

The construction work has involved building airstrips and many miles of steep, twisting mountain roads; blasting and chiseling mountain tops to accommodate the buildings and massive steel antennas; building fuel and water systems. At some locations it was necessary to build temporary heated enclosures around entire buildings to keep layers of ice from coating the framework.

Behind the Link

No story about White Alice would be complete without a tribute to the people who have made the project possible—Bell System people drawn from all levels of responsibilty and experience, Air Force and Corps of Engineer people, and the many fine Alaskan craftsmen who contributed so much to the construction phase of the job.

Many of these people have been separated from homes and families for long periods of time. Many have undergone severe hardships and hazardous conditions. They have worked long hours under unfavorable circumstances. In doing so they have done more than a day's work and have taken in their stride many formidable tasks which lesser men would have shirked.

White Alice also has taken the combined management and technical skills of the Bell System Companies, the manufacturing and supply facilities of the Western Electric Company and the research and development abilities of the Bell Telephone Laboratories. Hundreds of companies large and small (more than 300 electronics firms alone) cooperated by furnishing equipment and materials on tight schedules which often meant disrupting other production schedules.

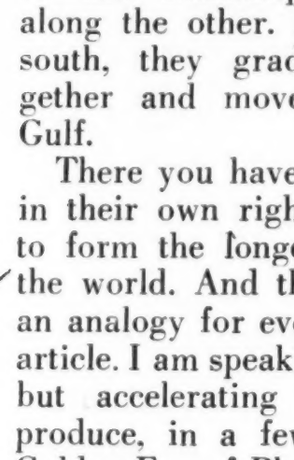
As important as White Alice is to Alaskan and American defense, its successful completion is also marking a tremendous new accomplishment in the art of communications. Until White Alice was undertaken, beyond-horizon radio was considered in the experimental stage. Its only previous use was over a trial route in Newfoundland. White Alice circuits now in service have proven the ability of this technique to provide communications circuits of the highest quality and have established beyond-horizon radio for future service of bettering communications among men of good will.

As the Honorable Anton Anderson, the Mayor of Anchorage, Alaska, said at the service cutover for the first White Alice links in November of last year, "This system has been properly named. To me it is Alice in Wonderland." And as Alice said to the Gryphon in Lewis Carroll's famous book, "'I could tell you my adventures, beginning from this morning,' said Alice a little timidly, 'but it's no use going back to yesterday because I was a different person then'."

And so it is with Alaska; it is and will be a different person today and tomorrow with its growth potential improved by modern communication facilities.

Golden Era

photography - electronics



by

Don G. Mitchell

CHAIRMAN OF THE BOARD AND PRESIDENT

SYLVANIA ELECTRIC PRODUCTS, INC.

ON THE WAY OUT TO THE COAST A while back, we flew at about 20,000 feet through some of the clearest weather I have ever seen. As we approached the Mississippi, the pilot announced over the p.a. system that we would cross the river just north of St. Louis. And so I moved over nearer the window to get a better look at one of the most beautiful sights you can see from the air—the joining of the Mississippi and Missouri rivers.

The visibility was so good that day that I could see a sharp separation between the waters of the two rivers even after they had joined together—the Big Muddy was running along the west bank, and the clear waters of the Mississippi were running along the other. But as you looked south, they gradually blended together and moved on toward the Gulf.

There you have two mighty rivers in their own right, joining together to form the longest river system in the world. And there you also have an analogy for everyone reading this article. I am speaking about a gradual but accelerating trend which will produce, in a few short years, the Golden Era of Photography to parallel the Golden Era of Electronics, just as certainly as those two rivers will continue to join together.

This trend involves electronics on the one hand and photography on the other, and for the next few moments I should like to make a few observations about these two large and increasingly related fields which will draw ever more closely together in the years ahead.

Because the entire economy has been growing so steadily since the end of the war, with the Gross National Product running today at the rate of probably $420 or $425 billion annually, the trends in various individual industries cannot help but be obscured somewhat by our economic progress as a whole. After all, when a football team is piling up seven or eight touchdowns, with everybody taking turns carrying the ball, it's pretty difficult to single out any one man. Nevertheless, one man usually begins to stand out above the rest. Perhaps he's a little faster, a trifle more intuitive, or more resourceful, and you remember him more than anyone else.

It seems to me that is the case in industry today, except for the fact that there are two standout performers, rather than one . . . electronics *and* photography.

Let's look at electronics a little more closely, so that we can have a better basis for seeing just how closely these two fields will draw together in the future. I don't know of any more logical place to start than at the beginning, but the problem is finding the beginning. You might say electronics began when Marconi developed the wireless, or when Lee De Forest invented the vacuum tube. Or you might move ahead a few years to the 1920's when radio broadcasting was developed. However, it seems to me that electronics, in the sense that we regard it today, really emerged from World War II, when for the first time we began to see the enormous future ahead of us.

The radio manufacturing and broadcasting industries rose to a volume of several hundred million dollars by the time we entered the war, and that's not peanuts in anybody's book. But when you get right down to it, they represent only a single phase of the industry as we know it today. They were the forerunners of an industry which leap-frogged across the equivalent of 25 or 30 years of technical progress during the five war years, and which has grown in 15 years from an annual volume of half a billion to $12 billion, and from employment of some 70,000 to more than ten times that number today.

This unprecedented growth—and I want to underscore that word "unprecedented"—makes electronics today the fastest growing of all the major industries. No other single industry can match it. The enormous variety of electronic products available at this very moment, and the day-after-day introduction of new ideas and new concepts makes one fact abundantly clear—the progress has been tremendous, but we have only scratched the surface. There are so many fruitful possibilities in this amazing field that one of the most difficult decisions for any company to make these days is deciding which direction to take next—and you have an infinite variety of directions from which to choose.

Two Areas of Electronics

There are really two general areas of electronics. One is composed of the products which are essentially electronic from start to finish—the products which would not exist at all without the electron tube—TV, radio, the electronic brains, and so on. The other area is the application of electronics to something which has been done before mechanically or electrically, but not electronically. It is a case of using electronics to control something, or to compute or to memorize, and so on. This is the field with the largest potential—because it embraces every product area—military, commercial, industrial, and

consumer. In the military field, for example, the passive defense system for the new B-58 supersonic bomber is not comprised of armament in the usual sense. It is a shield of electronics which surrounds the plane and stands ready to repel any missiles which might be directed against it. In industry, electronic controls on production and materials handling equipment are becoming increasingly commonplace. On the administrative side of the business, electronic data processing is taking the drudgery out of inventory control, ordering and billing, marketing research, and many other tasks where the paperwork sometimes becomes so monumental that the *end* is all too frequently completely obscured by the *means*.

The magnitude of this area of the electronic industry is in the billions. Defense electronics is at the level of some $3 billion a year and will continue at a high level for years to come. Commercial and industrial electronics are a billion-dollar business today, or more than twice the entire industry in 1940. And yet this field is only in its infancy. Within five or six years, volume should have increased by $500 or $600 million or more, and be up around $2 billion by 1965 or even sooner.

It is extremely difficult for the average person to visualize commercial and industrial electronics because he is not aware of any direct contact with it. And yet his long-distance call goes over microwave links, or his power company may compute his light bill and tens of thousands of other bills in a matter of minutes instead of hours and days; and in more and more banks, the accounts are computed electronically, and any errors which might crop up were probably made by a human being, and not an electronic machine.

Systematic Application

Yes, electronics has become the heart of national defense, and it is moving gradually into industrial processes and commercial applications—but the market with a potential that absolutely defies even a wild guesstimate is the consumer market. Some product lines can be charged with reasonable accuracy on the basis of population trends, continued growth in standard of living, and so on. But the technological factor in consumer electronics is so predominant as far as the future is concerned, that the traditional long-term market projections are really only the barest of minimums.

As the electronic device and the electronic component move toward broader and broader consumer application, there will be one pitfall which must be scrupulously avoided. And that comes under the heading of "over-engineering." It happened in major appliances, as many of you will recall. When relays and controls were first applied to washing machines, for example, there were plenty of headaches for the consumer and for the serviceman, and I honestly think that this resulted from trying to do too many things at once. The refrigerator escaped that period, because the engineers approached that venerable device more conservatively, and first developed a hermetic-sealed motor, and then automatic de-icers, and all the rest, but they didn't pile on everything at once.

The point is this: If electronics is applied systematically and logically, to automobiles, to home-heating and air conditioning, to home lighting, *and* to photography, the public will find itself with another invaluable aid to modern living. But so-called "packing" with electronic gadgets, and doing something by electronics that doesn't need electronics any more than good Scotch needs ginger-ale, will only provide a first-class nightmare for everybody. The engineers call this being "gadget-happy," but all too frequently they are the same boys who keep loading gadgets on a consumer product until you have to take in a young engineer as a boarder in order to keep the thing running.

Unlimited Potentials

If there ever was a field where electronics has a logical and unlimited potential, that field is photography. The drawing together of these two major industries can be traced back to that phenomenon we know as "light," and the use of light to produce images. Light, of course, has been the very heart of photography since its beginnings, but using a stream of electrons to pick up the reflection of an image and then to reproduce that image on a screen miles away was accomplished on a practical basis for the first time only a short time before World War II. These were the early versions of television and radar. and from the day those achievements were recorded, it has been inevitable that electronics and photography would find increasingly common grounds and draw steadily closer together.

As we look back at the television of the late 1930's and at the early work done by the French on the predecessor to radar, we know now that these were among the major scientific break-throughs of all time. For years the electron had performed the masterful job of turning sound into an electrical impulse and back into sound. But with television and radar, the electron jumped out of this narrow confinement and joined photography in a realm which contributes more to the welfare of mankind than any of man's five senses—the sense of sight.

Here was the harnessing of light in a new form to bring information, amusement, and education to millions of people—more rapidly and more directly than ever before. However, I certainly do not feel that television is the achievement to end all achievements. Many of the technical accomplishments of television have been in a basic sense, photographic achievements. Or to put it another way, television and photography are so inter-related that where one stops and the other begins cannot be pinpointed. What we really seem to have is a complete blending of two different techniques and two different arts, and each can learn a great deal from the other.

Here is a case in point. The other night my wife and I went to the movies, and I must confess that it had been many weeks since the last time. I had become so accustomed to television pictures and television techniques that I was almost startled by what I saw on the screen. First, it gave the impression of being three-dimensional, although I realize this was an illusion, but the photography had a quality that no television program has been able to accomplish, and that quality was amazing flexibility. I recall saying to myself, "If television had this flexibility, and if motion pictures had television's immediacy and speed, what a combination we would have." Some day, I am sure, and perhaps it will be sooner than we think, these two techniques will merge completely, each drawing from the inherent advantages of the other. And that to me examplifies what electronics and photography can contribute to each other.

There is a situation in television, however, which I cannot resist commenting upon briefly. You and I have seen an amateur armed with the best camera money can buy and have watched him take just about the worst photographs we have ever seen. By the same token, television as a technical phenomenon is all too frequently far superior to the programs it transmits. That presents a major challenge to those of us in photography and electronics, because I strongly feel that one of the basic

responsibilities of a manufacturer is not only to assure high product quality but also to do everything he possibly can to make his product serve its fullest purpose.

So that we can review some of these possibilities more fully, let's first take a look at some of the achievements of the photographic industry. Right at the outset. you will note that the post-war achievements of the photographic industry have paralleled very closely the developments in entertainment electronics, which again suggests their natural affinity. The emergence of television as a mass medium since 1947 and 1948 was accompanied by the emergence of amateur photography as we know it today. The factors which stimulated and fostered both of these developments have their similarities—the steady growth in population, more leisure time and increased interest in recreation and travel, steadily rising incomes, and superimposed upon all the others, the continued strength of the economy.

Sales Soar

The consumption of electric power is always an extremely significant barometer, especially when it doubles in the short space of 10 years to the point where it now exceeds 500 billion kilowatt hours. While this was going on, another "doubling" was taking place—the dollar volume of camera and projector sales, and the consumption of film and flashbulbs.

Let's tie that down to a few specific instances. Cameras are now selling at the rate of some 6 million units a year, and the lion's share of that market represents, of course, the amateur. Colored film consumption has grown to the point where nearly 30% of the 2 billion film exposures made by amateurs last year were in color. That figure was only 7% in 1950.

Just the other day we learned that photoflash bulb production in 1956 totalled nearly 625 million units—which was more than 13 times the output of 10 years ago. You dealers know the reason: Amateurs consumed only 10% of the bulbs in 1946, but today they represent 95% of the market. For all of us in the photographic business, that adds up to a bright picture, if you will excuse the pun.

Just as in the case of the electronics industry, however, those output and sales figures may be impressive, but they are only the beginning. Here is an example: The 2 billion pictures taken by amateurs last year averaged out to about 57 pictures per household—or about five rolls of film per household per year, using the typical 12-exposure roll. Think of the additional volume that could be realized solely by encouraging each household to take one more roll of pictures each year. I only wish every sales opportunity were as potentially fruitful as that.

For the past few moments we have been scanning the production and sales side of the picture, but how about the technical side—or are we still in the horse and buggy phase that prevailed for so many years before the war, when a camera was a camera and film was film, and that was that. The photographic industry has no need for concern on that score. During the past several years, more technological progress has been made in photography than in the previous two or three decades. Pause for a moment and consider some of the items we accept as a matter of course today—American-made high-quality cameras that are at least equal to foreign-made cameras, color-coded cameras that eliminate the mysteries of lens stops and shutter speeds, all-purpose midget flashbulbs, faster films, low-cost camera kits, easy-to-operate range finders and exposure meters and many others.

On the other hand, I sincerely feel that many of these impressive items will be effectively obsoleted within the space of a very few years. The research and engineering now under way throughout the industry is attacking every major problem and is aggressively seeking to attain every major goal—especially the solution to such long-established problems as reducing the size of photographic equipment without sacrificing picture quality or increasing the cost of the equipment, or providing greater simplicity of operation through practical and workable automatic devices which combine accuracy with dependability.

The first of these research goals—reductions in equipment size—means that within the next decade or sooner, we will have smaller and more portable still and motion picture cameras, and portable projectors and viewing equipment. Lighting equipment will be more compact, too, with still smaller flashbulbs, magazine flashguns, and electronic flash units suitable for an amateur.

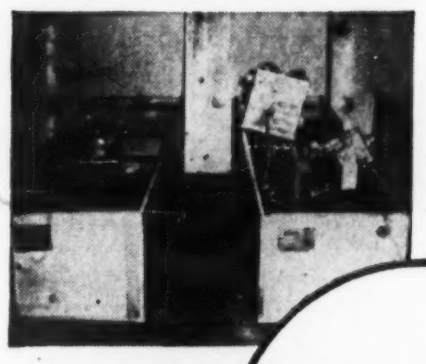
The second of these major goals brings electronics into the picture—the achievement of photographic equipment that will be easy to operate because of practical and work-

(*Continued on page* 14)

America's critical northern defense projects, the DEW Line and White Alice, are reaching completion. Hughey & Phillips helped Western Electric and the Blaw Knox Companies solve severe requirements by engineering and fabricating complete ready-to-install kits.
These kits include

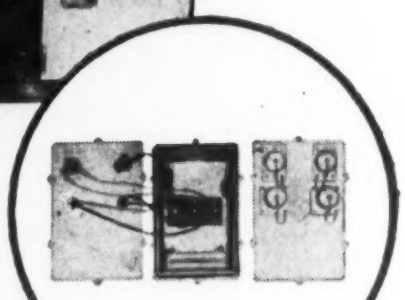
- **SLEET MELTER POWER & CONTROL CIRCUITS**
- **SPECIAL LIGHTING AND CONTROL CIRCUITS**
- **TOWER OBSTRUCTION LIGHTING**
- **LAMP FAILURE ALARM SYSTEMS**
- **EMERGENCY TELEPHONE CIRCUITS**

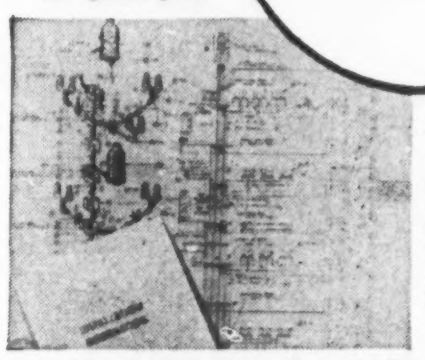
This practical experience and knowledge is available to you in solving problems in these or similar systems employing photo-electric control units, beacon flashers, obstruction lamp failure indicator and controls. Complete systems will be engineered, fabricated and packaged in a kit for your *specific job.*



System being packaged for shipment

Special junction boxes with terminals and cable support, engineered specifically for your job.





Complete installation information and diagrams are included in each ready-to-install kit.

Write today for information regarding your specific problems.

HUGHEY & PHILLIPS, INC.
Manufacturers of
300MM Beacons, Obstruction lights, Photo-Electric Controls, Beacon Flashers, Special Junction Boxes, Microwave Tower Light Control & Alarm Systems, and complete kits for: Tower Lighting, Sleet Melter Power & Control.
3200 N. SAN FERNANDO BLVD.
BURBANK, CALIFORNIA

able automatic devices. Not too far from now, the fully automatic camera will become commonplace, and the amateur photographer, who today clings to the box camera because of the seeming complexity of more precise photographic equipment, can cast aside his final apprehensions. The focusing and exposure timing problems will be automatically solved within the camera. And there will be a greater latitude of exposures in films for acceptable pictures.

Progress and Probabilities

As many of you know, one of the most promising areas of electronics is the field of semiconductor devices, such as the tiny transistor which is finding increasing application in the amplifying and switching of electrical impulses in many kinds of electronic equipment. Developments in this field may be translated into important benefits to the photographic industry. As you know, all amateur photography today is based on silver, due to its effectiveness in film developing. It is entirely possible that in the future growth of the solid state physics field a completely new basic photographic process may be achieved for capturing an image.

This may seem more than a little "blue-sky" today, but the camera of the 1960's will use electronics to adjust the lens, cock the shutter, and wind the film. And the flashgun will be equipped with a clip or drum similar to those used on automatic guns.

There will be another kind of progress. Many of the devices now used by professionals and advanced amateurs, will go increasingly into general use, as a direct result of simplification and cost reduction. I am thinking about ultra-high shutter speeds and fast films, and variable focal-length lenses, which have achieved such spectacular success in professional photography. And don't forget infra-red and ultra-violet photography, a technique which has barely been touched by the amateur.

Carrying electronics more deeply into photography, one of these days you will be able to take motion pictures on magnetic tape and play them back through your television receiver, which by that time will be flat-wall TV, available in every room in the home. Three-dimensional projection seems to be on the horizon, and electronics again may provide the solution.

These have been only some random possibilities—or perhaps I should say "strong probabilities"—and we could add perhaps a dozen or more without too much time and effort. However, when you combine all of the possibilities I have mentioned, and then make due allowance for the many others that have not occurred to us. I am sure you will agree with me that our photographic industry is on the threshold of one of the greatest periods of growth and diversification that any industry has ever known.

No matter where you look, everything seems to be in the industry's favor. As if the normal population growth were not enough, together with our continually rising standard of living, there are two special situations which are worth mentioning. One is the bumper crop of World War II babies. These children, born between 1942 and 1945, will be in their upper 'teens by the 1960's and that is an age bracket that constitutes a major market for photographic products; witness the fact that teenagers in nearly 10,000 schools throughout the country are today active in photographic activities of some sort, including regular classes, camera clubs, and the like. This widespread interest will undoubtedly be six or seven times greater in five or six years, as the awareness of this constructive and productive activity continues to grow.

The Era Ahead

Everywhere you look these days, new chapters are being written in the history of photography—but the bookshelves that have been reserved for the volumes of the future stretch almost to infinity. Not even the remotest semblance of a line can be drawn to indicate where photography might be in 1967 or 1977. And I would say that the only other industry with as great a potential and as great an unknown is electronics. Together, these two fields have an era ahead of them that is difficult to measure, from any standpoint—whether it be quantity or usefulness.

But you and I know that a *potential* means only one thing—it is possible of attainment, but there is no built-in guarantee. Everyone in the electronics and photographic industry, and the thousands of others who will be joining these industries in the future, have a golden era ahead . . . a golden era, to be sure, but also one in which the competition will be tough and imaginative and versatile. But the opportunities for success will be greater than ever—both for the organization and the individual.

Exciting new things
are happening at

HOFFMAN ELECTRONICS

Out of advanced electronics research and development at Hoffman comes an entirely new concept in ground radar. Still under wraps by the Military, this unusual and practical Hoffman development applies revolutionary techniques to solving complex weapons systems problems.

Hoffman's extensive experience in designing, developing and producing radar for airborne and shipboard installations laid the groundwork for this exciting new electronics development. In radar, as in other vital military and commercial fields—countermeasures, navigation, weapons and communications systems—Hoffman continues to produce the pattern for progress in electronics.

In a dynamic industry where only change is permanent, exciting things continue to happen at Hoffman.

PHYSICISTS • ELECTRONICS AND ELECTRO-MECHANICAL ENGINEERS

Significant new developments at Hoffman in the fields of navigation, VLF, HF, VHF, UHF, radar, ECM, weapons systems and semiconductors have created important positions for scientists and engineers of high calibre. Please address inquiries to Chief Engineer.

Hoffman Electronics

HOFFMAN LABORATORIES, INC.
3761 South Hill Street
Los Angeles 7, California

"radar's caught infiltration on hill four zero..."

As at sea and in the air, Hoffman-developed radar now gives our Armed Forces greatly extended capabilities for surveillance on the battlefield. It's another outstanding example of . . .

Hoffman Electronics

Where exciting new things are happening in RADAR

HOFFMAN LABORATORIES, INC.
3761 South Hill Street
Los Angeles 7, California

RESEARCH
DEVELOPMENT & PRODUCTION
WEAPONS SYSTEMS
COMMUNICATIONS
NAVIGATION
ELECTRONIC COUNTER MEASURES
RADAR
SEMICONDUCTOR APPLICATIONS

ELECTRONIC ... on ance ring

By Lt. Gen. C. S. Irvine, USAF, Deputy Chief of Staff, Materiel

AT THE OUTSET OF THIS article, I want to repeat something I have said many times. There is a job to be done, and the best way to get it done is to understand our industry-military problem. The sooner we reach that understanding, the better chance we'll have of producing operationally effective electronic hardware.

We are not intent on acquiring a stockpile of military weapons and delivery systems, solely for the purpose of keeping people working and happy. Our defense efforts do not stem from a militant philosophy. The plain fact is that so long as aggressive Communism continues to build a mighty war-making potential, we have no alternative, except to stay ahead of them—in other words, to have whatever force it takes to deter their drive for power.

To emphasize the position we are in, and to support my insistence that our electronics people *must* do more than they have yet done, I want to give you a few comments about the Soviets. With this as a background, I next intend to describe our managerial approach to producing better hardware, faster. Finally, I shall underscore the requirements facing the electronics industry and its engineers in the months and years ahead.

You have read and heard a lot about how the Soviets have progressed in aircraft development and production, and there is ample evidence of the success they appear to be having with nuclear weapons. The question that may arise is—just how do they stand, time-wise, with regard to our own advancements.

Without going into specific intelligence reports, we can deduce that their lag is virtually non-existent. Scientifically, they are moving rapidly and *on their own.*

They have revealed a radar capability, which implies a tremendous advance in the state-of-the-art. Further, their technical advancement in the electronics and radiation fields was confirmed at the Geneva Conference. I saw some of their electronic gear during my visit last summer. I am convinced that their engineers are about as competent as our own people. They develop more than marginal reliability into their equipments.

They simplify as much as possible, and, so far as I could tell, their equipment is truly specialized. In regard to work with reliable, high performance tubes—there is good reason to believe they are up with us.

To further their own knowledge, and *to avoid wasting time by duplicative research and development,* they keep abreast of what is going on in the outside world by reading scientific reports and journals originally done in other languages. They have over 3000 people working in a large, government-run library which translates, files and abstracts the technical papers from all over the world; information available in the most recently published reports is distributed to their scientists within a matter of days if the topic warrants priority treatment.

I do not mean to paint a gloomy picture, but I do want to impress on you the facts as they appear to us. As I have said before, the Soviet *rate of progress* in almost all technological fields is currently greater than our own. We should all be gravely concerned about it. It is this concern that we need to instill in both technical and management people.

With these facts before us, we have no alternative but to extend the lead while we possess an *existing* degree of airpower superiority. This means that we must convert knowledge into military hardware *now.* It means, especially, that the electronic segment of our industry must translate its language and symbols into tangible black boxes for our aircraft, missiles and ground control equipment. In the military we must simplify and streamline our procedures and our specifications. Whenever possible, we must make civilian and military standards coincide.

Let me say right here, though, that we can't create these complicated devices without proper management. By that, I mean that electronic components are parts of subsystems, and their creation must proceed in a systematic guided fashion. In other words, interrelated elements must be integrated into a workable whole, else we'll wind up with a hodge-podge of over-weight, ill-fitted, unreliable gimmicks.

To give direction to design, development, and production efforts, the Air Force has set up the subsystem approach as a managerial tool. It is quite similar to the weapon system concept of procurement. A prime electronic contractor is selected to design, assemble, *prove out,* and deliver a complete subsystem which will be incorporated in an air vehicle or as part of the ground support network.

Let me make it clear, however, that this prime contractor is *not* arbitrarily selected. Rather, we make a comprehensive facilities survey, just as we do under the weapon system concept—studying the company's organizational and managerial structure, its current commitments that could interfere with work completion, its production potential, and most of all its design and engineering approach to the problem.

Further, once it has a contract, it does *not* have a concurrent authority to tool up and produce all parts and components. It is required to establish a well-planned, coordinated subcontract structure and to farm out the production of as much of the work as reasonably can be done by smaller specializing firms.

This subsystem approach offers three decided benefits: For one thing,

it provides for more rapid development through the use of several engineering staffs, rather than one. Additionally, this means that the end item should stem from the creative thinking of a larger cross-section of electronics experts, insuring greater performance.

For another benefit, this approach leads to dispersal of Government business to more companies, making for a sounder industrial economy.

Most important, however, the subsystem approach fosters more and better coordination of design and production engineering efforts. This is an *absolute must* in this era of highly complex equipment and the critical shortage of engineers.

We are convinced that this managerial approach to building electronic subsystems is a sound one. It leads to a specialized, simplified, integrated product, arrived at by plan instead of by-guess-and-by-golly.

But notice: I said it *leads* to this product. *It does not make it.* The approach is a tool of management aimed at keeping design-development-production gears well oiled and running smoothly. In the final analysis, its effectiveness is only what our engineers and production men make it.

In the light of immediate and future air vehicle performance goals and their impact in terms of electronic equipment, engineers across the Nation have a grave responsibility. To emphasize this fact, let me remind you briefly of our current weapon systems inventory.

In our bomber fleet right now we are replacing the B-36 with the B-52 long-range bomber. We have the B-47, B-57, and B-66 tactical bombers in our active units. Immediately beyond these, the upcoming supersonic B-58 is showing greater promise as a possible follow-on for the B-47.

Additionally, our fighter and interceptor aircraft are reaching an advanced stage of modernization. These include the F-100 day fighter and fighter bomber, F-101 fighter bomber and fighter interceptor, the F-102 fighter interceptor, F-104 superiority fighter, F-105 fighter bomber and F-106 fighter interceptor—all in the supersonic class, and each one a specific complex design for a definite operational requirement.

In the missile field, we are pushing the Titan and Atlas ICBM's (Intercontinental Ballistic Missile), the Thor IRBM (Intermediate Range Ballistic Missile), the Snark air-breathing missiles and the Bomarc interceptor. While these are proceeding as rapidly as possible, considering the costs, complexity and state-of-art, we know it will be some little time before they can be introduced to replace part of the manned bombers. In the meantime, we are making extensive studies in regard to both chemically powered and nuclear powered aircraft for supersonic long-range bombers as follow-on for the B-52, and to be used in conjunction with the ICBM's and IRBM's.

Performance-wise, we have set our sights on speeds of over Mach 3 and altitudes of more than 15 miles for manned aircraft, for the immediate future. During the next ten years, we want to shoot for Mach 10 and altitudes far exceeding anything now possible with the current state-of-the-art. Also, we want to extend the range of specialized bombers to such a point that we can make a round trip flight between here and any spot on the globe without refueling.

In close conjunction with these delivery systems, we must have effective electronic devices *that are absolutely reliable,* and that exceed in performance anything that the Soviets have or will have. These, I know, are far-reaching requirements, impossible ten years ago and difficult today. But for tomorrow's deterrent force *they have got to be facts of life.* In over 35 years of military service, I have found that the only safe prophesy is that weapons and their method of employment will change, for progress itself is changed for the better.

But let's get down to cases—as far as you are concerned. In the first place, electronic subsystems are the heart and soul of ballistic and air breathing machines: timing, guidance, and aiming devices, navigational systems, sensing and lock-on equipment—the list is long. Except for the body and the propulsion system, these machines are in fact numerous electronic subsystems integrated into a workable whole.

An Electronic Complex

The activating force of our total Air Defense structure is an electronic complex with a three-part sequence: ground detection of aircraft, ground-to-interceptor guidance, and interceptor-to-foe homing and fire control. Each of these three is dependent on the other, and total reliability of the whole system demands 100% reliability of each separate one.

Our retaliatory strength will be effected directly by the capability of electronic devices. It makes no difference how *potentially* damaging our bombers are, unless they break through the enemy's defense net and drop bombs accurately on assigned targets. We have a high standard to uphold.

Now—I'm not pretending to pass along this information as something new or startling. You are as well acquainted with these needs as I am. My purpose is to lay them out before you and to impress upon you—and upon the companies, laboratories, and research centers—the magnitude of the work to be done. The first task needing consideration involves creating certain critically needed tubes. especially those required by our electronics counter measures program, our advanced radar system, and our next stages of communication.

We are looking forward to the advanced oscillators and amplifiers such as the traveling wave tube and expect its availability in terms of years. We need it now. This tube, besides being voltage tuned, has the interesting characteristics of widely variable band width, the ability to transmit on several frequencies at one time, and a tuning range in the order of two to one.

Being an amplifier rather than an oscillator it can form the desired signals and frequencies at low level and then amplify them to the power we need. We anticipated their use as far back as 10 years ago. But the rub is this: While we have known the theory, we haven't gotten very far. And that's the job in front of you and your companies. It is essential that you get busy and convert your formulas and equations into hardware—something we can sink our testing teeth into.

With American know-how resting comfortably on its laurels, I am concerned because it is possible that European nations have the jump on us.

Of course, I realize that companies may have been reluctant to move into this field because they felt that the equipment the Air Force desires would not have a direct commercial application. I am certain that advanced amplifiers and oscillators will have wide commercial application and will appear on the foreign market, perhaps, before they do here.

It is only common sense to coordinate design efforts with materials engineers, tool designers, subsystem contractors and production engineers, toward the goal, not merely of nursemaiding one handmade product, but of laying the ground work for mass production. This effort should not be limited to an article which, when finished, performs reliably only within the confines of a laboratory. It should anticipate the adverse vibration and heat conditions in its operational environment.

Greater simplicity is needed. It has been said that equipment has been over-designed, and therefore over-priced, for the performance of military missions. It may be only that the compiex laboratory standards we are trying to use are too high for Service operation. Perhaps we should approach commercial standards and simplicity for our military purposes. Military aircraft and engines tend to do the pioneering and developing for our commercial airlines and our private flyers.

In electronics, because of the much wider commercial market, it seems imperative to me that we should move forward in our development and production standards on a broad front which will meet both military and civilian requirements.

So far, *production* itself has not been a bottleneck. By that, I mean that we have usually had on hand the number of items required for assembly. Notice, though, I said *production of numbers* had not been a problem. But reliability and efficiency of operation have been problems—critically serious ones. And of especial importance insofar as the defense communications network is concerned, incompatibility of interrelated subsystems has resulted in serious deficiencies.

Administratively, we are conducting an intensive program to establish certain operating norms which should lead to reliability factors. Progress in this effort appears to be very satisfactory. But these reports are after-the-fact statements. The best way to cure these malfunctions is to engineer fool-proof mechanisms operating well below maximum outputs.

Unfortunately, specification ratings too often allow only a slim margin between normal conditions and extreme situations such as supply-voltage variation, load variation or even manufacturing variation. As a consequence, installed items, when subjected to take-off, cruise, and landing operations, too frequently malfunction.

The point I am making is that you must extend greater effort to ruggedize marginal components, or so alter the design that malfunctioning will not result in mission failure.

At the same time, we must endeavor to reduce the scope of the job and limit our specification requirements to the bare minimum. We must have hardware that will run even if it will not accomplish every job that the fertile minds of our military and civilian technicans can envision.

Additionally, I urge you to eliminate after-manufacture adjustments as much as possible. Present black boxes are essential to us because all too often our maintenance people are not engineers and therefore cannot set controls as accurately as you can in your laboratories.

Space does not permit me to itemize all the types of component weaknesses and shortcomings that have resulted in product failure. But, failure reports tell the sad story.

However, there are occasions when we must take a calculated risk, and we have with HF, VHF and UHF, with the bomb nav system, and with the fire control system. Here is the pattern of one sample item: 1948—development started; 1950—production contract let, with prototype scheduled for one year later; 1952—production delivery due, but dates not met; 1953—engineering changes further delay delivery; 1954—1955—tremendous technical difficulties, a terribly high failure rate, a sadly discouraged and highly vocal operational command; 1956—final satisfactory operation of the de-bugged unit.

In summary, the Air Force asked for too much, too soon. The company promised too much, perhaps with tongue in cheek. Obviously, looking back at this program, there was not enough management, by either the Air Force or company. This sample could be applied to any one of the major electronic systems which the Air Force has installed in its aircraft. We get there eventually, but it sure is a rocky road.

Another problem we have discussed at length is that of compatibility. This is primarily a design shortcoming, too often resulting from inadequate coordination between the different engineering staffs which are responsible for related components or companion subsystems. These range from frequency and voltage discrepancies, inadequate power availability, and data link code distortion; to errors such as inadequate space allotment for black boxes, mismatched connections, and too great a separation between related components within the air vehicle, or no provision for cooling.

If you think for a moment I am exaggerating these problems, talk with some of your technical representatives who have seen the difficulties we have encountered, and who have had to substitute make-do modifications for real engineering. Or go to the Air Proving Ground Command or one of our tactical units and just listen to the poor crew chief—he can't get his job done in a forty-hour week.

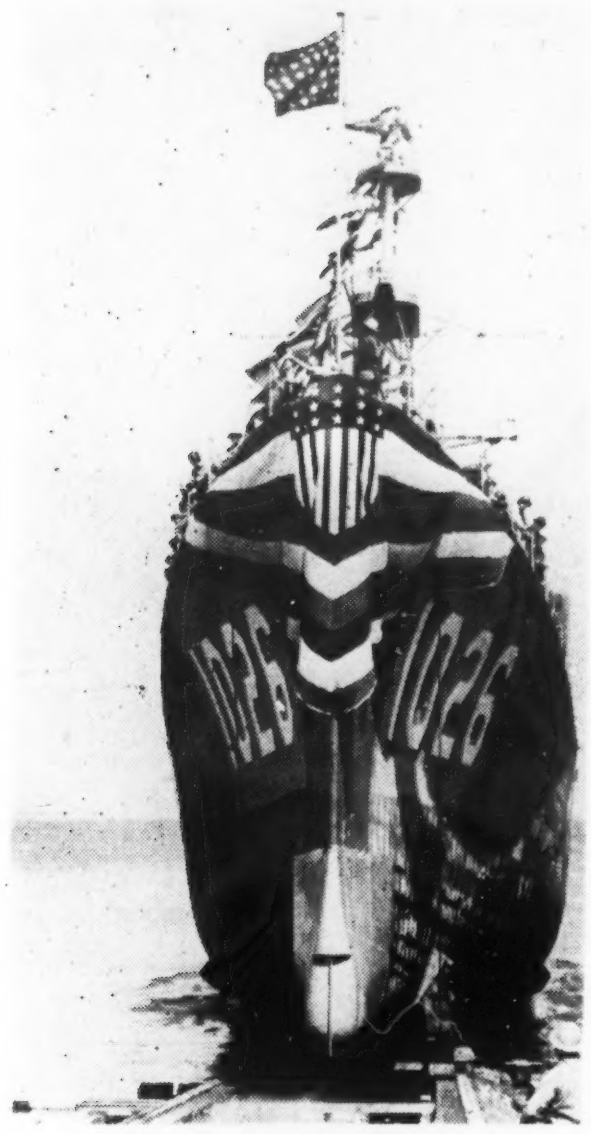
Now—I realize that my comments here have a negative tone to them. In fact, you may get the idea that the electronics picture is totally black. This is not the full truth. In my opinion, it is just a dull grey. Some of our companies have shown real initiative and individual effort. Their designs showed originality and offered material improvements in performance. Some of our Air Force procedures show signs of modernization. But world circumstances and the urgent need of our aircraft, missiles, and communications network do not allow me to indulge in my favorite pastime of commending people for work well done. I am forced to call for more and better effort than we have yet put forth.

Courses of Action

In conclusion, then, let me repeat the obvious: *To an ever increasing degree, electronics will determine the true effectiveness of our military capability as a deterrent force.* We are so dependent on this field of endeavor that we can neither defend ourselves nor retaliate without its products. But the products have to be more efficient, more reliable, and far simpler from the maintenance point of view than anything yet offered. And they have to come faster than in the past.

Recently, you've read and heard that the Soviet Union is facing some serious difficulties within its industrial complex. You may have been told that they are producing at a slower rate than in the past. I do not intend to deny those reports, but I am afraid we would be going down the "dream-world" path if we interpreted those reports to mean that Soviet emphasis on military technology is letting up. In all likelihood, the simple truth is that they are facing scientific barriers and are concentrating their efforts on less publicized but highly important new devices.

Make no mistake about it. They have not retracted from their avowed intention of dominating the world. In face of probabilities where the Soviets are concerned, we have only three courses of action to follow: First, to produce the best, most efficient, most reliable end items our trained minds can create—and to produce them in sufficient quantity to assure our continued air power superiority. Second, to upgrade the training and motivation of our scientists, our design engineers, and our production engineers to higher and higher plateaus of achievement. And third, to stimulate and activate the hearts and minds of our young men and women to fully participate in the geometric upswing of our electronic future.



a TRIBUTE *to a* LEADER

★ ★ ★ ★

A new destroyer escort, *USS HOOPER* (DE-1026) was launched August 1, 1957 at Bethlehem Steel Pacific Coast Shipyard, San Francisco. The new destroyer escort was christened by Miss Elizabeth L. Hooper of Washington, D. C., daughter of the late Rear Admiral Stanford C. Hooper, USN, Navy Communications pioneer for whom the ship is named. It is designed for anti-submarine search and attack warfare, scouting and convoy duty and will be fitted out by January 24, 1958.

The late Rear Admiral Hooper graduated from the U.S. Naval Academy in 1905. He is often referred to as having been "the father of Naval Communications." His Naval career ashore and afloat was most distinguished. He occupied many important positions and received a number of civilian awards in the field of communications and numerous commendations. In recognition of his outstanding military service, he was presented the Navy Cross.

Following seven years at sea and an instructorship at the Naval Academy, in 1912 Rear Admiral Hooper was appointed Fleet Radio Officer, a post that he himself had suggested as necessary for the proper administration of the new method of communication.

In the period 1915 to 1928, he was the guiding spirit in developing Naval Radio from little more than a toy to the essential communications medium it had become by the latter date. In the first few years he pushed through to completion the world-wide chain of land stations, furnishing the first communication between the Navy ashore and the Fleet at sea. In 1925 he went to sea as U.S. Fleet Radio Officer on a cruise to Australia and carried out the Navy's pioneer tests of what were then very high frequency waves. The reports made at that time had a tremendous influence on the development of this field by the Navy and all other radio interests.

Many new features appeared as standard in Naval radio equipment during this development period, largely through Rear Admiral Hooper's influence and under his personal direction. Perhaps the most outstanding was the radio direction finder. It was due to Rear Admiral Hooper's leadership and drive that Naval Research Laboratory became an activity.

From 1928 to 1934 he served as Director of Naval Communications, during which time in 1930 he was appointed a member of the President's Radio Board.

For many years, Rear Admiral Hooper served as a member of the Interdepartment Radio Advisory Committee; as delegate, or technical assistant, to practically all international radio conferences; as Navy liaison with Congressional Committees on Communication matters, and as Chairman of the radio group representing the Government departments, marine and aviation interests in all radio matters, particularly international. It was his original recommendation which resulted in the formation of the Radio Corporation of America, thus creating an all-American world-wide communications company to free the United States from dependence on foreign controlled radio communications.

From 1939 until 1942, he served as Director, Radio Division, Navy Department, and in 1942, was made Technical Assistant to the Vice Chief of Naval Operations, Navy Department. In 1945 Admiral Hooper began his retirement and it was in this year that he was selected as a winner of the Elliot Cresson Gold Medal, awarded by Franklin Institute, "in consideration of his pioneering leadership and practical utilization of discovery in the field of radio for the U.S. Navy."

Besides his many military decorations, Admiral Hooper received the Medal of Honor of the Institute of Radio Engineers, "for the orderly planning and systematic organization of radio communication in the government service and the concomitant and resulting advances in the development of radio equipment and procedure." Also, the Marconi Memorial Medal of Merit of the Veteran Wireless Operators Association was awarded to him, "for outstanding contributions to the radio art, particularly in building up the wireless communication system of the United States Navy from the status of an engineering experiment to a major military arm for control, detection, and communication."

The Armed Forces and Communications Electronics Association is proud to have had Admiral Hooper as one of its members. We are pleased that one of our Nation's Naval destroyers will bear his name—for this is indeed a deserving tribute to a leader and pioneer who devoted his life to a Naval career and a better America through communications.

...By Jove!

ASW* is a Navy need in protecting our nation's supply lines . . . as guardian of our coast line . . . if the time ever comes when an underwater aggressor wants to pose his threat. Like Jove, god of the skies, the Navy's *Anti-Submarine Warfare techniques will be poised to seek and sink that threat . . . with a complete electronic search, track and kill package especially designed for the aircraft and the mission. ➢ ➢ For economical and operational efficiency, the LMEE "Tri-A" (Advanced Airborne ASW*) system will fill a true Jove-like function . . . in seeking the aggressor . . . and as a thunderbolt in destroying it. ➢ ➢ This is only one of many LMEE advancements in sonobuoys, displays and search systems. Along with the development and production sections in Utica, its Advanced Electronics Center at Ithaca, New York, is making important contributions to passive systems studies. Coordination between LMEE engineers and Naval research scientists *can* wipe out tactical advantages the submarine has traditionally enjoyed. Write Department D.

LMEE

AVIATION ELECTRONICS PRODUCTS INCLUDE

WEAPONS CONTROL RADAR • SEARCH RADAR • INDICATORS AND DISPLAY
COUNTERMEASURES • NAVIGATION MISSILE CONTROL • AIRBORNE SONAR
COMMUNICATIONS • FUZES • AUTOMATIC TEST • DATA PROCESSING

Progress Is Our Most Important Product

GENERAL ELECTRIC

LIGHT MILITARY ELECTRONIC EQUIPMENT DEPARTMENT
FRENCH ROAD, UTICA, NEW YORK

A DEPARTMENT IN THE DEFENSE ELECTRONIC DIVISION

— GOVERNMENT —

ATOMIC CLOCK FOR ARMY The National Company, Inc., Malden, Massachusetts, announced it has received a $609,525 contract from the Army to produce experimental military atomic clocks, called atomichrons. The company said the clocks generate their own power and are so accurate that they can be used as standards, besides being designed for use in a disaster where no reference to standards would be possible. By utilizing frequency control, the instrument corrects continuously the signal of a crystal oscillator that drives the clock. The compact and rugged atomichrons can withstand great shocks, acceleration and wide temperature ranges.

"PANATRACK" A device for simulating the actual flight path of a space vehicle has been developed by engineer Edward J. Madden, Corps of Engineers' Research and Development Laboratories, Fort Belvoir, Virginia. Called "Panatrack," the device projects a moving view of the terrain over which the vehicle "flies," showing the area as it would be seen by an observer in a space ship or satellite. The apparatus consists essentially of a projector inside a globe.

DEPARTMENT OF DEFENSE SUMMARIZES STRENGTH OF ARMED FORCES On June 30, 1957, the total combined strength of the Armed Forces was 2,794,411. This represents an increase of 4,581 from May 31, 1957. Breakdown figures—Army, 997,916; Navy, 676,532; Marine Corps, 200,893 and Air Force, 919,070.

NAVY TO USE "ELECTRONIC BRAIN" TO STUDY VANGUARD FLIGHT A specially-designed electronic brain, known as the Automatic Recording and Reduction Facility (ARRF), will be installed and placed in operation at the Air Force Missile Test Center near Cocoa Beach, Florida, by early fall. The ARRF automatically processes flight information from each of the three-stage VANGUARD test vehicles and satellite launching vehicles, and final data can be provided in less than 72 hours after a firing. This is a joint development of Radiation, Inc., Melbourne, Florida, and the U.S. Naval Research Laboratory, Washington, D. C.

WAGES AND PRICES The final score of the effects of world-wide increases in labor costs has not yet been written. According to figures compiled by the United States Department of Labor, hourly wages in the United States have increased about 42% since 1950 and consumer prices about 20%. Figures showing increases in hourly wages and consumer prices in other countries are: Canada—52% and 18%; Great Britain—55% and 42%; West Germany—52% and 15%; France—90% and 38%; netherlands—48% and 32%.

FCC MEETING ON PAY-TV The Federal Communications Commission will take up the subscription-TV question at a special meeting on September 17. Thus, they will resume the pay-TV question which was reviewed in August before the agency recessed.

CONTRACTS: ARMY: Collins Radio Co., investigation of theory and application of scatter circuits in tactical systems and developing tropospheric scatter system, $426,079; Melpar, Inc., technical assistance for Army aircraft electronics systems and equipment tests and studies, $753,089; Times Facsimile Corp., engineering test model, polaroid facsimile system, $50,000; Fairchild Aircraft, research and development for manufacture of high speed surveillance drones, $12,000,000; Willys Motors, Inc., further work on Mechanical Mule, $6,783,424; Philco Corp., radio relay units and associated parts, $10,000,000. NAVY: Hazeltine Corp., ship instruments, $5,443,337 and decoding equipment, $1,180,283; Packard-Bell Electronics Corp., radar test equipment, $300,000 and production of IFF (Identification, Friend or Foe) equipment, $1,000,000; Ryan Aeronautical Co., automatic navigators, $348,016; Federal Telecommunications Labs., development of transmitting equipment and amplifier, $99,600. AIR FORCE: American Bosch Arma Corp., facilities and support of ballistic missiles, $1,922,290; Kollsman Instrument, azimuth computer, $2,651,127; Otis Elevator, bombing and navigational radar trainers, spares, data and equipment, $2,230,547; Westinghouse Electric Corp., production of 3600 magnetron tubes, $1,400,000; Texas Instruments, Inc., photographic mapping radar system, $1,394,318; General Electric Co., fire control system, $16,000,000.

— INDUSTRY —

SMALL "BRAIN" A high-speed digital computer, "Leprechaun," has been built at Bell Telephone Labs. Leprechaun is about the size of a home TV set and requires less power to operate—only 9,000 electrical components. It can take its instructions immediately from its memory no matter where the instruction may be stored. The machine can store 1,024 "words" in its memory—each "word" consisting of 18 binary digits. Developed under an Air Force contract, the new computer is to be used for programming and logical-design research on digital computers for military real-time control applications.

RCA CLOSED-CIRCUIT TV SYSTEM GUARDS GATE Television has joined the guard force at the Esso Standard Oil Company's refinery research laboratories in Baton Rouge, Louisiana. Two RCA "TV Eye" cameras are installed at a turnstile gate, which bars the entrance to the grounds. The closed-circuit installation enables Esso guards to control the gate in an office hundreds of feet away where they can see and confirm the credentials of employees seeking entry. One camera shows a clear view of the person and the second camera televises the employee's identification badge.

AUTOMATIC TELEPHONE DIALING James Kilburg, the inventor of "Dialaphone," an alphabetical index that automatically dials up to 890 pre-picked telephone numbers, has signed a contract in San Mateo, California for manufacturing of the device with Western Electric Company for Bell Telephone System, and also with Automatic Electric Company for independent telephone companies. The self-contained unit connected alongside the telephone, is operated by turning a hand crank to locate a name on the alphabetical listing, then the starter key is pressed to complete the call automatically. The dialaphone will be available from local telephone companies on a subscription basis only.

"READING" DOCUMENTS ELECTRONICALLY Solartron Electronic Group, Ltd., of Thames Ditton, Surrey, has devised an electronic "reader" aimed at making information from documents instantly available to computers without resort to human middlemen. The electronic reading automatic (ERA) scans the document at the rate of 300 characters a second and feeds information directly into a computer by means of electrical impulses. Solartron and Rheem Manufacturing Co. of New York have formed a jointly-owned company called Rheem-Solartron, Ltd. to do research and development work on the ERA and other electronic devices.

— GENERAL —

NORTH AND SOUTH POLE "HAMS" Two American scientists, Dr. Charles R. Bentley and Maurice J. Davidson, who are engaged in research for the IGY, have succeeded in communicating with each other between the North and South Polar regions. The scientists, both of whom are from Columbia University, reported reception on the "Ham" radio band "clear as a bell," although the distance between their stations is more than 11,200 miles. It is believed to be one of only two such direct conversations from the Arctic to the Antarctic.

"RETMA" NOW "EIA" Radio-Electronics-Television Manufacturers Association (RETMA) has changed its name to Electronic Industries Association (EIA). The organization felt that EIA more simply and adequately describes the present character and growth potential of "our expanding industry." Other changes—the set division will be known as the consumer products division, and the tube division will be expanded into a tube and semiconductor division.

NATIONAL ELECTRONICS CONFERENCE More than 10,000 persons are expected to attend the 1957 National Electronics Conference at the Sherman Hotel in Chicago, October 7-9. A total of 96 technical papers, six tutorial talks and three luncheon addresses will be presented during this 13th annual conference. A record 245 commerical exhibits will be on display with most of the nation's leading electronics manufacturing and research laboratories represented. The event is sponsored by the American Institute of Electrical Engineers, Illinois Institute of Technology, Institute of Radio Engineers and Northwestern and Illinois Universities.

ATOM FAIR The 1957 Trade Fair of the Atomic Industry is scheduled for October 28 through 31 at the Coliseum in New York City. The sponsor, the Atomic Industrial Forum, has offered to send AFCEA members Complimentary Atom Fair tickets on request. Ticket requests should be made on business letterhead, and addressed to: Atom Fair, 3 East 54th Street, New York 22, New York.

ACCURATE AUDIO FREQUENCY

1 part in 10^7

NEW FORK UNIT DESIGNED FOR HIGH ENVIRONMENTAL VIBRATION USES. SENSIBILITY TO EXTERNAL FORCES IS REDUCED AT LEAST ONE ORDER OF MAGNITUDE THROUGH VIBRATION RANGE OF 2 TO 2000 CPS WITHOUT SHOCK MOUNTS.

INHERENT STABILITY IS AT LEAST 1 PART IN 1 MILLION ±5°C OR 1 PART IN 10 MILLION WITH [illegible]N.

FORK FREQUENCIES 1000 TO 5000 CPS.

LONG TERM DRIFT LESS THAN $5/10^6$ PER YEAR.

TIMES FACSIMILE CORPORATION

540 West 58th Street, New York 19, N.Y.—1523 L Street N.W., Washington 5, D.C.

BIZMAC

electronic brain joins the Army

by A. L. Malcarney, Executive Vice President, Defense Electronic Products, RCA

WHEN NEWSPAPER COLUMNIST H. I. Phillips heard recently about some of the fancy feats the new Bizmac electronic "brain" was performing for the Army, he remarked: "This sort of thing can do away with the human head except for purposes of photography and shaving."

That, of course, is more than a mild exaggeration. Still the Army is finding out that RCA's Bizmac electronic data processing system can do some impressive things. At the Ordnance Tank-Automotive Command (OTAC) headquarters in Detroit, where it keeps track of the Army's spare parts all over the globe, Bizmac can:

- Complete in forty-eight hours an inventory procedure that once took up to three months.
- Process by computer in one hour as much work as 400 girls with hand calculating machines could turn out in the same time.
- Store on a single 10½-inch reel of magnetic tape as much information as was previously held in ten file shelves.
- Reduce by 85 per cent, over the next year, OTAC's visible records which are now on some 10,000,000 file cards, punched cards, metal plates and hand-written sheets.
- Record information on magnetic tape and read from tape at 1,700 words per second—a rate at which it could finish Tolstoy's "War And Peace" in about five minutes.

Bizmac is the latest and largest of a whole array of electronic data processing systems that are working an office revolution in industry, in commerce and in Government including the Armed Forces. The Army Signal Corps, Ordnance Corps and other services have shown great interest and ingenuity in adapting these systems to their own special requirements in logistics, financial and personnel management, record-keeping, and research and development. The Services have found, as Major General W. Preston Corderman, Commanding General, Fort Monmouth, N. J. Signal School and Laboratories, expressed it, that "with the tremendous capacity of electronic computers to process, to store, to memorize and to display information, untold amounts of space, of money and numbers of people can well be saved."

Bizmac Controls Inventory

At OTAC headquarters, a four-story, block-long, brown brick building in the southwestern section of Detroit, the Bizmac system is used for inventory control. The Command is responsible for the development, design, manufacture, storage, supply and maintenance of nearly everything needed to put a global Army on wheels and tracks, and keep it supplied with spare parts. Some idea of the vast scope of the job may be gleaned from the fact that a typical tank requires about 6,000 separate maintenance items, and a typical transport vehicle requires 4,000.

Altogether, OTAC supports about a million pieces of tank and automotive equipment. It supplies spare parts

for 145 different basic vehicles and over 1,200 different models. Its inventory includes more than 170,000 separate items, ranging from nuts and bolts to complete engines and transmissions. These spare parts are stored at twelve major depots in the United States and abroad, each depot serving the Army camps, posts and stations in its immediate geographical area.

What's In the "Brain?"

The depots feed information on their supply transactions into the Bizmac system daily. This information comes in over telephone lines and is received in the form of punched cards. It is then transferred to magnetic tape, Bizmac's basic storage medium, and stored in one of 182 tape stations. Each station can be connected to other units in the Bizmac system at the push of a button. The magnetic tape is run through one of the three sorters which do the electronic equivalent of "paper shuffling"—putting data in the proper sequence. Then the tape is processed through the computer which automatically updates the files and singles out items for the attention of the supply manager. When the computer finds a depot short of an item, it passes this information on to an electro-mechanical printer which prints re-order forms at the rate of 600 lines a minute. If one particular fact is needed quickly, an interrogation unit can search the system's 100,000,000 facts and find the answer within three minutes.

The uniqueness of Bizmac lies in the fact that it can handle more work than other systems because of its ability to do several operations simultaneously, and control and coordinate them from a central point. It can perform a file search at the same time it is posting information to an account and printing out the results of a previous computation. All these operations can be controlled remotely from a room, known as system central, which is similar to a telephone exchange.

Bizmac is designed to handle three main functions:

Keeping Inventory of Spare Parts. It maintains up-to-the-minute information about what supplies are on hand at each of the twelve accountable depots, how much is needed, what has been ordered and in what quantity, and how much material is in transit. By checking on supplies daily, Bizmac will permit an eventual reduction in inventories. This cut is expected to result in substantial savings on warehouse expenses, carrying charges, and loss through obsolescence. Major General Nelson M. Lynde, Jr., Command General of OTAC, estimates that the savings will amount to "many millions of dollars," and that Bizmac will pay for its initial cost of $4.1 million, many times over every single year.

Cataloging Spare Parts. Bizmac will make it possible to get spare-parts catalogs out to the various depots even before a new vehicle rolls off the assembly line. It will publish up-to-date catalogs within a few days after changes are made, instead of having a lag of several months as previously. Mechanization of cataloging will also aid OTAC in the change over to the Defense Department's new stock numbering system, designed to eliminate duplication among the three Armed Services.

Forecasting Supply Requirements. Bizmac is now keeping track of how fast the various parts are moving at each depot and predicting how many parts will be required in the months ahead. In the future, it will forecast how many parts have to be on hand or on order throughout the entire depot system to keep supplies flowing in orderly fashion from the production line to all users. On the basis of these forecasts, slow-moving items can be prevented from ever getting into the system to pile up as surpluses. Periodically, Bizmac will forecast the spare-parts needs for advance budget planning, and prepare financial analyses of inventory for the supply manager.

Favorable Results

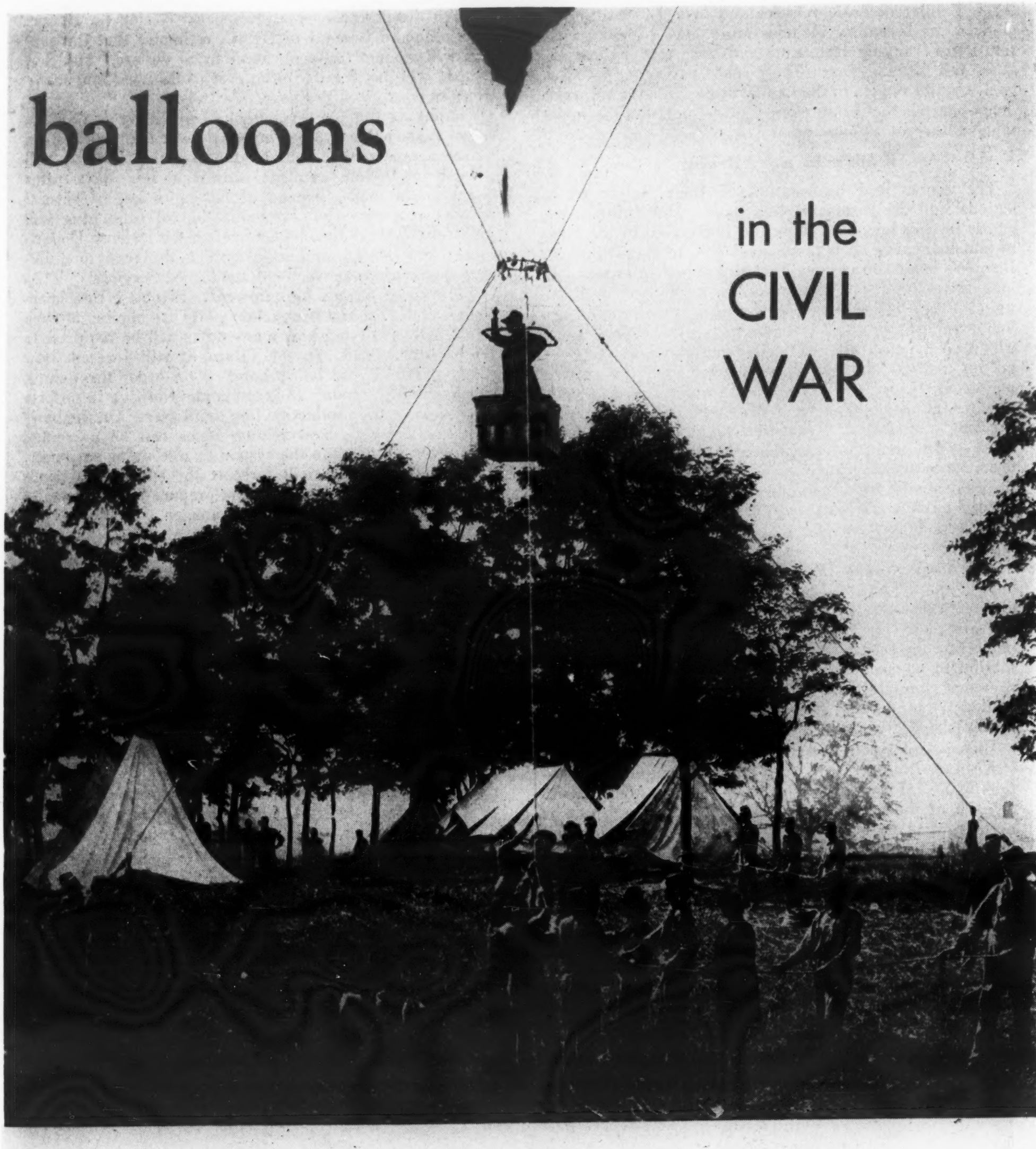
The Bizmac installation in Detroit includes some 220 units of nineteen different but fully integrated types of equipment. However, the system itself is highly flexible, operating on the "building block" principle so that a business organization can use as many or as few units as it needs to do its job. Several Bizmac systems are now on order with RCA, but the one at OTAC is the first to go into full operation.

General Lynde summed up the results to date in this way:

"From what we have seen of the Bizmac system in operation so far," he said, "we feel that it can contribute importantly to our job in two ways. First, it can streamline our operations and help the system to be more responsive to the Army's demands. Second, it can save the taxpayers substantial sums of money."

Watching the computer console of RCA's Bizmac electronic data processing system are (left to right) Dr. Elmer W. Engstrom, RCA's Senior Executive Vice President; Maj. Gen. Nelson M. Lynde, Jr., Commanding General of the Army Ordnance Tank-Automotive Command, and Arthur L. Malcarney, Executive Vice President of RCA's Defense Electronic Products.

balloons in the CIVIL WAR



by

H. V. CANAN
Colonel USA, Ret.

THE INTRODUCTION OF BALLOONS as a practical tool for war opened a new third dimension for military intelligence. Military students having foreseen their value, it was only natural that European armies had not overlooked their possibilities as elevated platforms for military observations. In the United States, the staff of the American army in mid-nineteenth century was preoccupied with Indian fighting and had little time for new military inventions. But, at the outbreak of the Civil War, professional balloonists were quick to rectify this oversight.

On April 18, 1861, less than one week after the fall of Fort Sumter, Thaddeus Sobieski C. Lowe, one of the better known aeronauts in the United States, brought the military potentialities of the balloon to the Nation's attention in a most spectacular manner. In what was to be a preview of a contemplated trans atlantic flight, he started on a free flight from Cincinnati, Ohio. Nine hours later he landed in Unionville, S. C., a distance of four hundred miles by air. His triumphant reception cooled considerably when abolitionist newspapers were found in the basket of his balloon. After considerable difficulty and two arrests, Lowe was able to establish his scientific status and was allowed to return North with his balloon.

About the same time James Allen, the first professional balloonist to volunteer his services to the Union, appeared in Washington with two balloons, but his appointment as a military balloonist did not materialize for several months.

Using city gas to inflate his balloon, Allen made his first ascension June 6th, 1861. An attempt three days later was short-lived because the supply of gas, obtained this time from a portable generator, was insufficient.

Official military observers of these early demonstrations recognized that balloons could be useful only if trained soldiers were permanently detailed to operate them.

Following Allen's demonstrations, Major General McDowell, in command of the Union troops in Virginia, asked for a balloon to reconnoiter during his advance on Manassas. Allen was given this assignment. His efforts were coupled with bad luck which was to plague balloon operation during the formative period of the balloon corps. One of Allen's balloons burst during its inflation, and the second tangled with some telegraph poles en route to Falls Church, Virginia, and was damaged. It was not Allen who failed; it was his equipment, and this ended Allen as an independent civilian volunteer balloonist. During the next year when Lowe re-entered the picture and headed the balloon corps, Allen was appointed a military aeronaut and eventually became chief of the balloon service.

The Corps of Topographical Engineers had been given the responsibility for developing balloons for military purposes. They requested bids from several aeronauts and in June 1861 a contract was awarded to John Wise. Wise, an able balloonist, was directed to construct a military balloon for $300. His arrival in Washington in July coincided with Allen's difficulties across the Potomac.

Failure At Bull Run

When Allen failed General McDowell, Wise, having been appointed a military balloonist, was ordered to move forward to Bull Run with his balloon. Difficulties in obtaining gas delayed his departure until the day of McDowell's defeat on June 21, 1861. The working similarity between balloon observers and the Signal Corps, in transmitting findings to ground forces, prompted Major A. J. Myer, the Chief Signal Officer, to request and obtain permission to accompany the balloon forward. By noon of the 21st, a caravan of men was only halfway when sounds of battle warned them to move faster if the balloon was to play any part in the engagement. Against the wishes of Wise, Myer had the inflated balloon tied to an escort wagon so that it could be moved forward at a trot. In this rough treatment it caught on some trees and the fabric was punctured. If the movement forward had continued, the balloon probably would have fallen into the hands of the Confederates. However, if the balloon had been present during the battle, it undoubtedly would have had considerable effect since the Union forces were almost without eyes while the Confederates were served with signal and observation stations.

Three days later when the balloon was repaired, Confederate reconnaissance detachments and artillery were observed near Arlington and within five miles of the Capitol. When the balloon was moved forward to be more useful, its mooring ropes were cut on telegraph wires, freeing it so that it floated toward the Confederate lines. Fortunately for the Union Army, it was shot down by their own rifle fire. McDowell's command had enough of balloons since their contribution was nil.

These two balloonists who had failed were supposed to be among the best in the country. Wise retired to his home and later entered the infantry where he served until he died.

While Allen and Wise were having their difficulties in achieving recognition, aeronaut Lowe arrived in Washington. Although he came late, he had good political backing. Consequently, he was received at the White House and a small sum of money was allocated by the War Department for two demonstration ascents. The first, in June 1861, carried Lowe and a telegraph operator five hundred feet into the air. From this distance the following message was sent directly to the White House:

Balloon Enterprise
June 18, 1861

To the President of
the United States.
Sir:

> This point of observation covers an area nearly 50 miles in diameter. The city, with its girdle of encampments, presents a superb scene. I have the pleasure in sending you this first dispatch ever telegraphed from an aerial station, and in acknowledging indebtedness for your encouragement for the opportunity of demonstrating the availability of the science of aeronautics in the military service of the country.
>
> T. S. C. LOWE

Similar messages were sent to other War Department officials. Here was a man who understood human nature and advertising.

A second demonstration, witnessed by the President, was held on the grounds of the White House. Several ascents were made at that time with Government officials and general officers. The newspapers praised the demonstrations and Professor Joseph Henry of the Smithsonian Institution sent the Secretary of War a detailed report of the public showing and his approval of the military use of balloons.

Immediately following the demonstrations, McDowell, who was ignorant of the enemy in his front and being in need of a balloon for his command in Virginia, requested that Lowe report to him. Lowe made a successful ascent and drew a map for

← Professor T.S.C. Lowe, who was instrumental in bringing to the Nation's attention the military potentialities of the balloon, prepares to observe the Battle of Fair Oaks, Virginia in 1862.

Professor Lowe's military balloon near Gaines' Mill, Virginia.

the Union Army command.

The commander of the Union armies, General Scott, had been unreceptive to the use of balloons. Lowe was received only through the personal intervention of the President, who escorted him to Scott. Because of this introduction, Lowe was hired in August as a military aeronaut. Although he was the last to be recognized officially, he rose to the top in balloon development and became well-known and well-liked by McClellan and the Topographical Engineers. He worked closely with Professor Joseph Henry of the Smithsonian Institution, whose approval of all plans and methods Lowe carefully sought before acting. His tactics gained for him the confidence and respect of the higher officials.

By the end of 1861, balloon operations were on a firm basis. Lowe had constructed six ballons which were operated by hired balloonists. Twelve horse-drawn field hydrogen gas generators, of the sulphuric acid-iron filing process, had been built. Each was capable of filling the largest balloon in three hours. A converted coal barge was added to the balloon service and from its deck balloons could be inflated and ascents made.

During the Fall and Winter of 1861, the balloons made frequent ascents and kept the Union Army fully informed of what the Confederates were doing in its front. The balloons never were better than during this static military situation. Military commanders took great personal interest in them, and Lowe personally was so much in demand for observation that he had difficulty in staying away long enough to make the new balloons which had been ordered.

Human nature changes but little, and even senior officers are fascinated by the new. One fine spring day a corps commander could not resist the call of the wide blue yonder and he ascended alone. At about 900 ft. elevation, the anchor rope gave way and the general floated off to the whims of the breeze. But, he had learned his lessons well. As he floated over the Confederate lines he made detailed reconnaissance. Then releasing ballast and rising higher he found a favorable current which brought him back safely within the Union lines. Thus were the Confederates deprived of a balloon and a corps commander as a prisoner of war.

As the balloon corps took shape, balloons were assigned to divisions, but operations remained under the technical supervision of Lowe and under the administrative control of the Topographical Engineers. As new balloons were delivered, additional operators were hired. They continued their good work and to them goes the credit for discovering, in the spring of 1862, that the Confederates had evacuated Manassas, thereby permitting McClellan to start his attack in the Richmond peninsula.

Once the movement of the Union army to the peninsula was decided upon and approved, events moved rapidly. A balloon was dispatched to Fortress Monroe and the report came that all was quiet there. Movement of troops started immediately. Lowe with his personnel and all of his equipment was ordered to Monroe. He moved with five balloons, ample horse-drawn field gas generators, and a train of about seven wagons carrying additional balloon and camp equipment.

Observation started as the army moved up the peninsula. The Army of the Potomac had been organized into corps and the normal assignment of balloons was to the corps. Lowe supplied his balloons with telegraph wire to facilitate direct communication with corps headquarters. In addition, he used signal flags with special codes or sent messages to the ground on rings sliding down the anchor ropes.

Although Lowe and his men ascended nearly every day, they did not discover Jackson's movement on the right flank of the Union line, a major factor in McClellan's retirement from the peninsula.

The success of the Union balloons impressed the Confederates. They made several attempts of their own, but lacked the necessary materials and operators. Their use of the balloon was never widespread.

Balloonists Adept at Reconnaissance

By 1863, balloonists had become adept at observing and reading signs. Under favorable terrain conditions, direct observation could often distinguish infantry units, cavalry scouts, outposts, artillery batteries, emplaced guns, field fortifications, and encampments. Smoke was a valuable source of information, whether it came from cannon or small arms, from camp fires, or from the destruction of bases and supplies. Density and color of the smoke was important in determining its source. When the distance was too great to permit direct observation of camps, smoke from camp fires could mark the size and position of the enemy. Camp fires almost invariably revealed the presence of the enemy and sometimes their number. Strength of a moving column was easy to estimate by determining the time it took to pass a fixed point, or if it was stationary or in position, by comparing its length and density with that of friendly troops whose numbers were known. To assure greater accuracy in identi-

fication, maps and field glasses were carried by observers and compass bearings were used to identify objects.

Attractive Targets

To obtain the best observation, positions near the front were desirable. This made balloons a favorable target for artillery. The enemy artillery could not resist the challenge of the sitting bird. Although some damage was done at times to the rigging, none of the balloons were hit in the envelope or basket, nor were any brought down by hostile artillery fire. The points of ascension always attracted casual visitors, and several generals were nearly hit by artillery fire when near balloons. Because they attracted fire, the presence of balloons was none too welcome by the troops and the balloonists were frequently asked to move their equipment away. In some instances Lowe found it desirable to construct shelter for his ground crews although only one member of his organization was killed during unit operations.

The failure to assign soldiers or to place the balloon corps on a military status determined the defeat of the corps in the summer of 1863.

The following criticism, made by an officer at Lowe's trial balloon run on the White House lawn in 1861, proved well-founded: The absence of military status and a permanent organization of trained soldiers and ground crew, rendered balloon management highly impractical. Responsibility was shunted from branch to branch without arriving at any satisfactory solution. The regular work of each branch was increased by detailing men for duty with the balloon corps.

Not having been granted military status, the highly-paid civilian balloon corps personnel incurred resentment and distrust despite their aeronautic ability and service. Since their observations were not always accurate, suspicion of the value attributed to such service was felt to be justified.

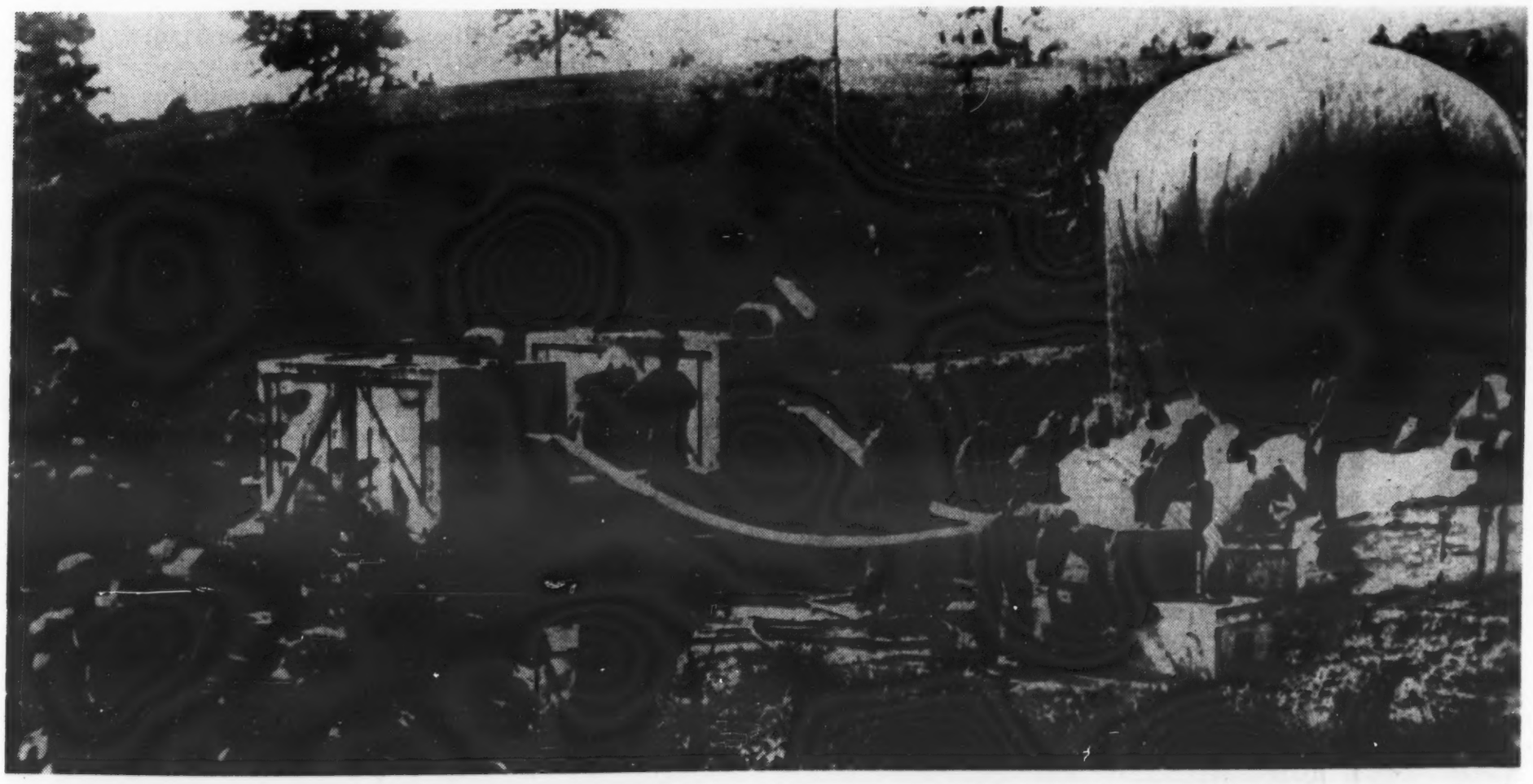
Finally in March 1863, the Corps of Engineers was delegated the administrative control of balloons, but the reception was far from one of kindly acceptance. Lowe's salary was drastically reduced, and he greeted the insult with a prompt resignation. However, during the emergency of the Chancellorsville campaign, Lowe patriotically served the corps, but without pay. A precipitant decline was effectively staged with the rude treatment of Lowe. Gradually, other technicans were dismissed, equipment was allowed to deteriorate and remaining officers lost interest.

A Strategic Decision

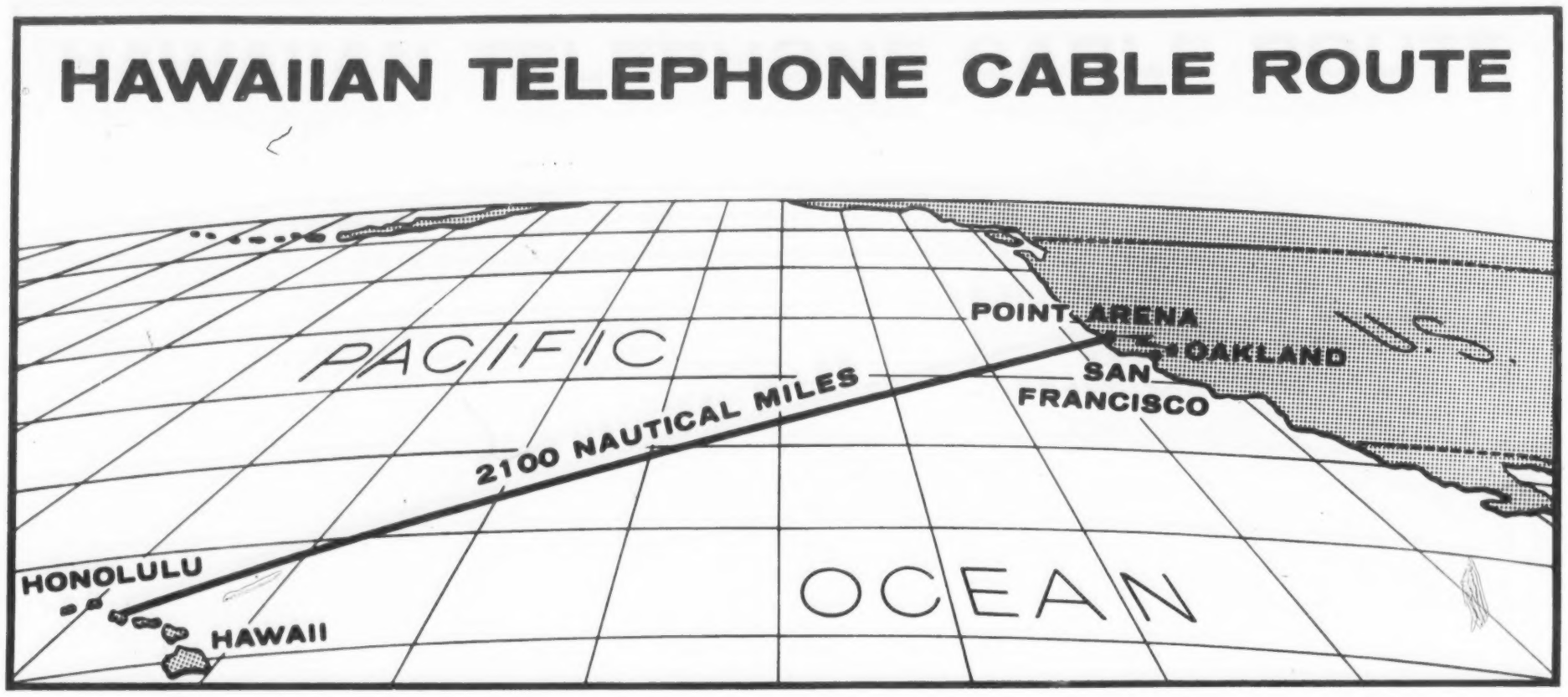
Finally, Hooker, following the battle of Fredericksburg, made a strategic decision which completely ignored the use of balloons as an intelligence instrument, bringing the corps to the brink of complete elimination.

Hooker, who had ultimately replaced McClellan as Commander of the Army of the Potomac, was making a strategic move up the river prior to the battle of Chancellorsville in 1863. Fearing that the Confederates would recognize his tactics, he decided not to risk the possibility of exposing his position by also moving the balloons. Although the balloon report on the movement of Confederate troops from Fredericksburg toward Chancellorsville had been of great value, the balloons were deprived of this last chance to prove their full potential. In June 1863, the balloons were transferred to the Signal Corps. Colonel Myer, Chief Signal Officer, requested but was denied both men and money for carrying on proper support and improvement. Failing to obtain this support, all balloons were subsequently ordered back to Washington and their use was completely discontinued.

Had the balloon corps continued, without doubt, its observations, which continually improved with experience, could have grown to become a highly valuable asset to the Union Army at Gettysburg, in the Wilderness, at Spottsylvania and with Grant at Richmond. Now stands the obviousness of that miscalculation wherein a most advantageous intelligence adjunct was allowed to pass out of existence at a time when its use implicitly promised to reach a peak of effectiveness.



Inflation of the balloon "Intrepid" to reconnoiter the Battle of Fair Oaks, Virginia. The battle, which took place from May 31 to June 1, 1862, was fought in the area just east of Richmond.



SIGNAL Staff Report

THE THIRD LINK

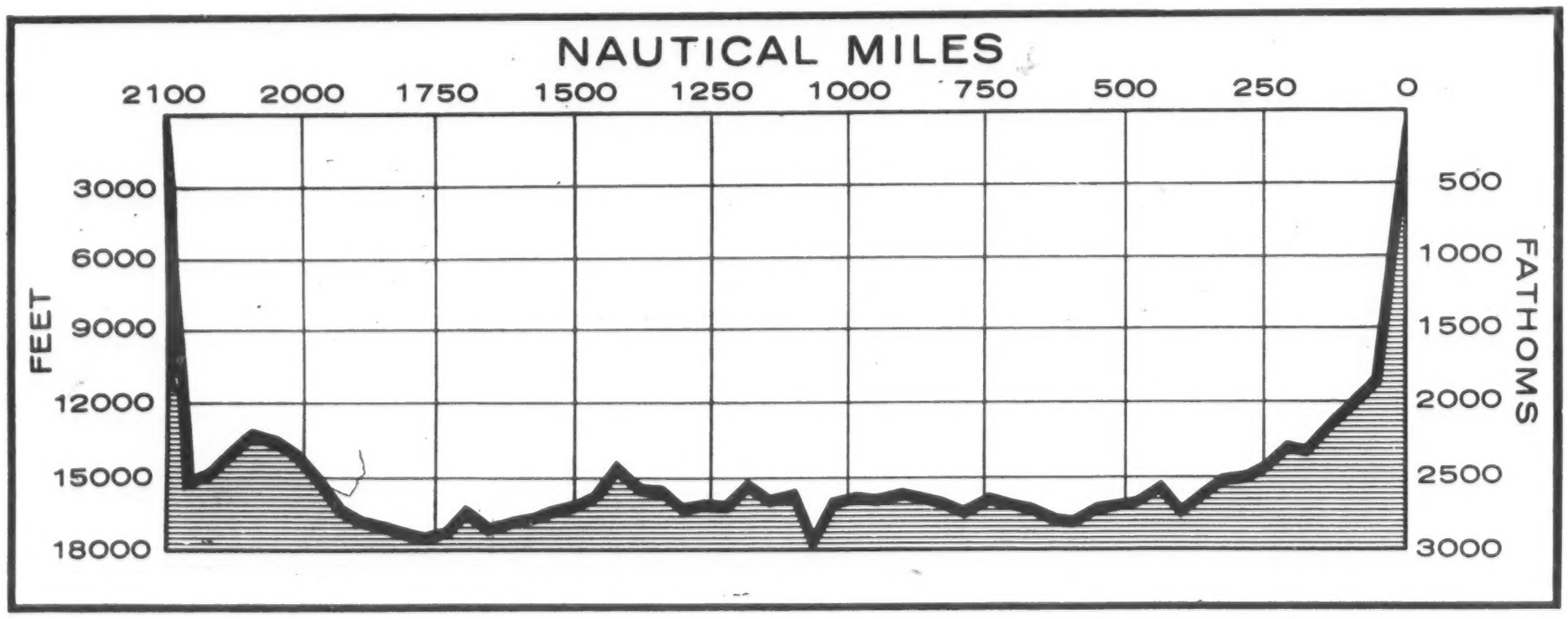
THE CABLESHIP MONARCH, GREY hulled veteran of scores of deep water ventures, sailed from San Pedro, California, July 12, 1957, on her biggest assignment—laying of the first undersea telephone cable link with Hawaii. This was to be the last phase of the multi-million dollar project which was started a year ago.

In September 1956, a survey was made to chart the topography of the ocean bottom between the California Coast and Hawaii, as little was known about the ocean bed beyond the continental shelf. It was necessary that the cable route avoid steep slopes, often subject to submarine landslides which could snap the cable, and to by-pass canyons where cables might be exposed to abrasion by ocean currents.

A depth recorder, which bounces sound waves off the ocean floor, was instrumental in the discovery of an unknown mountain beneath the sea, an 11,000-foot peak about the size of Mount Hood. The crew dubbed it "Mount Huddell" as a token to the ship used for the survey.

Other obstacles which had to be avoided were the Murray Fracture Zone, a trough four miles wide running 1200 miles east to west, and the "Moonless Mountains" which stretch 1000 miles north to south and rise two miles above the ocean floor.

Varying depths of the Pacific floor over which the cable is laid.



In April 1957, mainland shore sections were placed 10 miles seaward from Point Arena, California, amid pounding surf, swift cross-currents and treacherous undertow. After several ingenious but unsuccessful methods of beaching the cable ends were attempted, a helicopter finally picked up a towline from the beach and carried it above the surf to the work boat. The line was then hauled in by hand and later by tractor.

At the same time, 2,400 miles away at Hanauma Bay on the island of Oahu, Hawaii, charges of dynamite were exploded in off-shore reefs. Geyser-like shafts of water rose 100 feet in the air. The job involved trenching through razor-sharp coral to protect the twin shore sections of the cable. To make sure the trench was deep and smooth, skin-divers searched for jagged edges that might injure cable armoring. The shore ends extending two miles out to sea were floated to the beach from a shallow barge.

The cableship *Monarch*, playing the leading role in a multi-ship operation, began its task at Point Arena, site of the eastern terminus of the underwater twin cable system. According to the Long Lines Department of the American Telephone and Telegraph Company—Bell System unit in charge of the cable laying phase of the $37,000,000 project—the cableship picked up the end of a shore section placed there in April, spliced it to the cable in her tanks and headed for the Islands. Laying out 1,900 miles of cable at approximately six knots, *Monarch* steamed along on her south-westerly course.

By this fall, both of the 2,400 mile cables for the new Pacific voiceway will be completed. These cables will be capable of carrying 36 simultaneous conversations. Featuring the dialing of calls between the mainland and Hawaii, service is expected later this year. This will climax three years of planning and construction by Long Lines, the Hawaiian Telephone Company and Pacific Telephone and Telegraph Company, participants in the project.

Two other vessels will be engaged in the precisely timed, summer-long laying operations. They are the cable-laying *Ocean Layer*, and the cable supply ship, *Arthur M. Huddell*. Long Lines said there would be virtually no interruption in round-trip cable operations between the mainland and the Hawaiian Islands. Laying is to follow this sequence:

(1) From Point Arena westward, *Monarch* will lay the first 1,900 miles and buoy the cable end before proceeding to Honolulu.

(2) *Ocean Layer* will rendezous with *Monarch* at the buoy. She will take the cable end on board, make a splice and continue another 665 miles to the entrance of Hanauma Bay, on the island of Oahu. There, the east-west cable will be joined with one of the newly laid Hawaiian shore sections.

(3) Both cableships will then reload cable from the *Huddell* at Honolulu.

In Deep Water

For the second cable (west to east), *Ocean Layer* will pick up the second Hawaiian shore section and lay some 800 miles eastward and buoy the end. *Monarch* will pick up the cable end and continue to Point Arena for the final mainland splice. The cables will lie as much as 25 miles apart on the ocean floor.

The Hawaiian cable system is similar in design and construction to the 2,250-mile Atlantic telephone cables extending between Newfoundland and Scotland, and the 900-mile Alaskan cables between Port Angeles, Washington and Ketchikan, Alaska —both were opened to service in 1956. The transatlantic cable system was the first deep-water voice link to cross an ocean.

The Hawaiian cables will generally be in deeper water than either the Alaskan or Atlantic cables. At one point they will strike a depth of about three miles.

Cables are the coaxial type, especially designed to withstand the tremendous pressures of the ocean bottom. Sturdy, flexible repeaters are built into the cable about every 40 miles to boost the strength of signals when they reach the fading point along their deep-sea course. About 2,500 volts are required from each end to operate the cable system.

Long Lines pointed out that the compatibility between mainland and Hawaiian telephone facilities would enable an operator in Honolulu to dial direct to any telephone number in 6,500 communities on the mainland. In like manner, mainland operators in hundreds of cities can dial any subscriber on the island of Oahu, where 95% of Hawaii telephones are located. This will be the first of A. T. & T.'s ocean cable systems to be equipped for operator dialing.

The Hawaiian cables will substantially augment the 14 radio circuits presently operating between the mainland and Honolulu. When the cable system is placed in operation in the fall of 1957, it will also be used for teletypewriter service and for transmission of radio programs, but not for television transmissions. Wouldn't Queen Liliuokalani have enjoyed the opening of this important communication system?

AFCEA 1958 CONVENTION

Washington, D. C. **Sheraton Park Hotel** **June 4, 5 and 6**

(Wednesday, Thursday & Friday)

Programs & Exhibits ***All At The Sheraton Park***

Sessions: Top Level from Industry & Government

Objective: Biggest Communications & Electronics Show Held in Washington

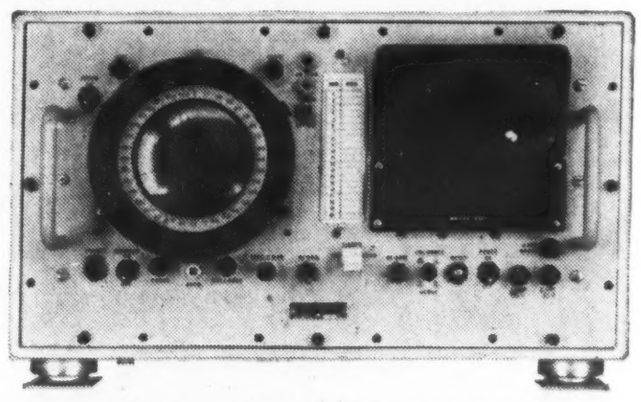
Tours — Luncheons — Reception — Banquet — Top Flight Speakers

FROM LONG-RANGE SEARCH RADAR TO SUBMINIATURE COMMUNICATIONS SYSTEMS!

Creative engineering and precision manufacturing are our business. In the communications and related electronic fields, Bendix* provides unlimited know-how and facilities. From the mightiest to the smallest, from the simplest to the most complex, Bendix radar and communications equipment possess the winning combination of proven design, precision manufacture, top performance and dependability.

Long-range Search Radar (AN/FPS-20)—one of our many products—is shown above. Now in production for the U. S. Air Force, this advanced type radar system culminates four years' intensified research, design and development by the Air Research and Development Command and Bendix engineers. It now plays a vital role in our national defense. Its dual-channel equipment includes high-powered transmitters and ultra-sensitive receivers far more sensitive and powerful than any other now in use.

By way of contrast the accompanying illustration shows the Bendix subminiaturized AN/ARC-44 communications system. It, too, figures importantly in our national defense. Now being produced for the U. S. Signal Corps, these rugged and reliable units are installed in small liaison fixed-wing and rotary-wing aircraft such as the L-19 Cessna and H-13 Bell helicopter for directing ground troops and artillery fire.



AN/URD-4 RADIO DIRECTION FINDER

Highly versatile Bendix unit used for many land and shipboard purposes. Locating carrier-based aircraft lost beyond the range of shipboard radar and locating by triangulation unknown sources of radio signals are but a few of its uses.

*TRADEMARK

Bendix Radio Division

BALTIMORE, MARYLAND

Bendix AVIATION CORPORATION

A 1957 AFCEA Convention Presentation.

Vanguard Instrumentation System

by Vernon J. Crouse, Group Engineer, Project Vanguard, The Martin Co.

TODAY THE SCIENTIFIC WORLD STANDS on the threshold of man's greatest adventure into the mysteries of our world and our universe. I am, of course, referring to the International Geophysical Year (IGY), which started July 1 and extends through the end of 1958.

The IGY will be a world-wide endeavor to obtain more information about man's environment. One of the most dramatic contributions to the IGY will be the United States' attempt to place an instrumented satellite into an orbit about our earth. Fantastic as this idea seems at first, I can tell you with all confidence that it is about to become a reality.

NRL Selects Martin

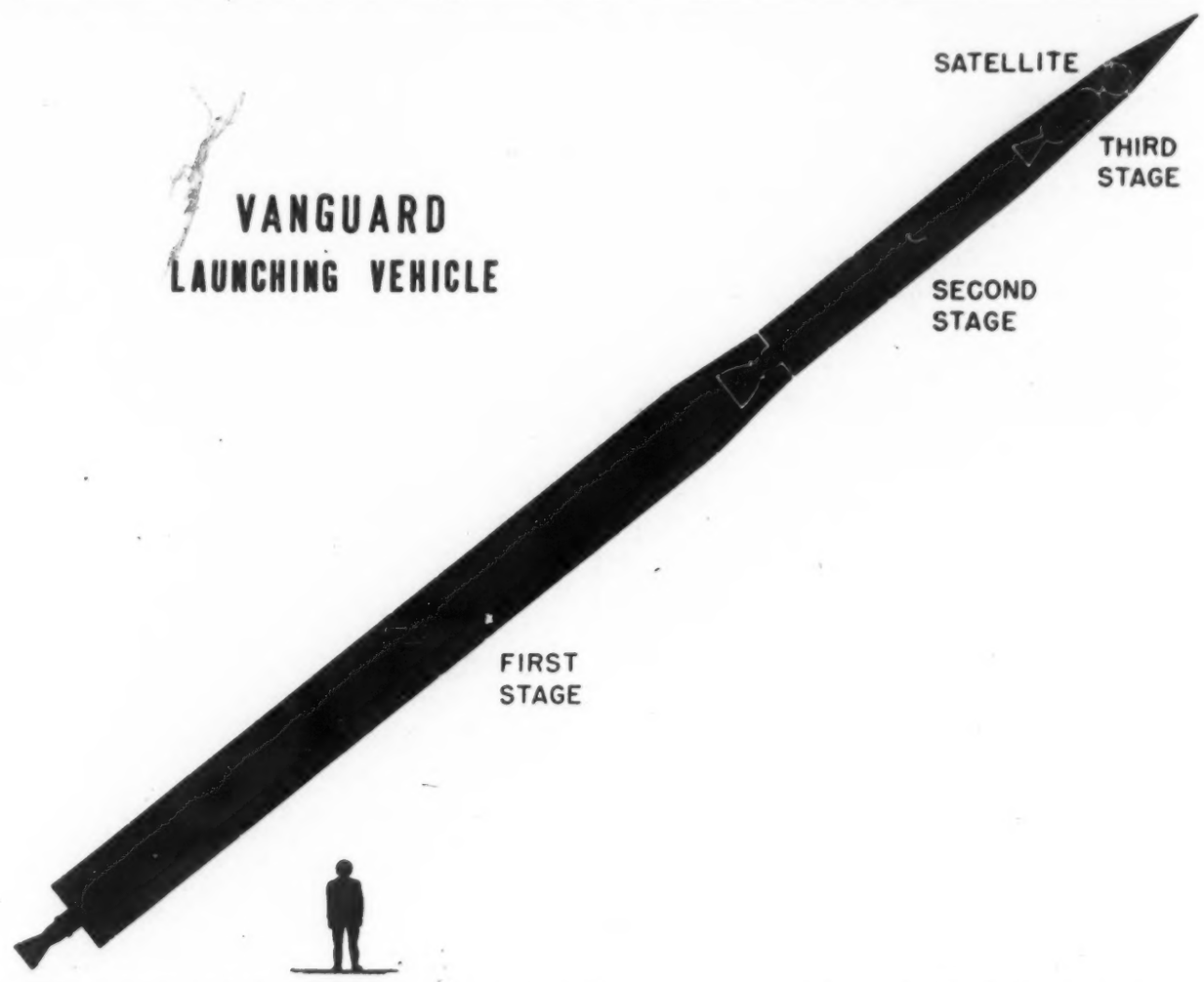
Shortly after the Presidential announcement on July 29, 1955, which officially started our satellite program, The Martin Company, Baltimore, was selected by the Naval Research Laboratory to design and build the satellite launching vehicle, Vanguard.

Almost everyone is now familiar with the configuration of the satellite launching vehicle (Figure 1) and the trajectory it will follow in order to place its satellite payload in orbit (Figure 2). It will require a giant three-stage rocket vehicle, weighing some 11 tons and standing as high as a seven-story building, to establish a 20-inch, 21.5-pound sphere in orbit.

To maintain an orbit will require maximum performance from all the different components that go into the complex launching vehicle. Foremost among these components are the electronic and communications systems that are needed to determine the performance of the vehicle and to establish the correct flight trajectory.

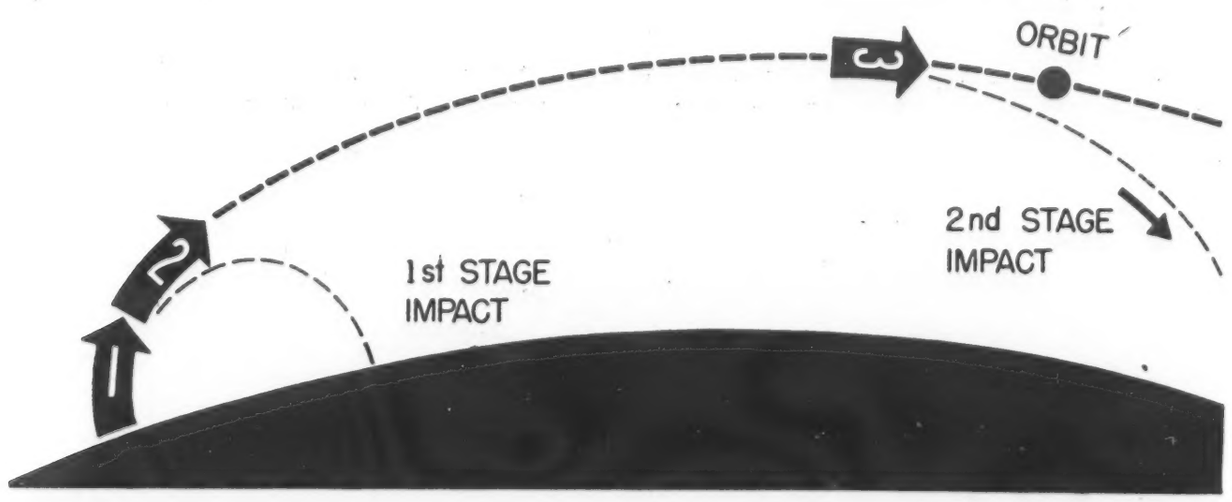
I'd like to discuss the instrumentation system of the Vanguard vehicle: the necessity for such a system, how it works, and what it is expected to do.

Naturally, the satellite launching will not be attempted until a thorough and exhaustive flight test program has been completed. The test program is planned to evaluate clearly the performance of all the components, the complete systems, and the design of the over-all



A three-stage rocket assembly, some 72 feet long and with a total weight of about 11 tons, will be required to get the scientific satellite, weighing about 21 pounds, into its earth-circling orbit.

FIGURE 1



Functions of the three stages of the rocket launching assembly are shown in this sketch of the trajectory. The first stage starts the system on its flight, drops off some 40 miles and two minutes later, after its fuel is spent. The second stage then takes over, burning out at about 130 miles altitude, and coasting on to the desired orbital altitude of 300 miles. At this altitude, the third stage places the satellite in its orbit, at a velocity of about 18,000 miles per hour. Over-all elapsed time: about ten minutes from take-off!

FIGURE 2

vehicle. Only after complete information has been received and analyzed will a satellite launching be attempted. As a matter of fact, the actual satellite launch vehicles will carry only a minimum of instrumentation; the Vanguard's performance will have been established by the test vehicles.

To give you an idea of what the test instrumentation will tell us, the performance of the first and second stage engines must be thoroughly analyzed; separation of the stages must be checked and proven; igniting the second and third stage propulsion units at high altitudes has to be tested and proven. Above all, the control system must be exhaustively checked, because if the rocket vehicle does not place the satellite at precisely the proper altitude, speed and position, the entire mission will be a failure.

The mention of just these few problems should impress upon you the amount of instrumentation that will be carried aboard the test vehicles. Each test vehicle will be fired to achieve a definite primary test objective, and several secondary objectives (Figures 3 and 4). Each rocket will carry an instrumentation system capable of making 200 internal measurements as well as complete external instrumentation. Telemetering will transmit this data to the ground.

As many as four telemetering transmitters will be used in each test vehicle. In addition, optical coverage,

MEASUREMENTS BY CATEGORIES

Pressures	58	Strains	7
Voltages	34	Flow Rates	5
Temperatures	21	Vibrations	4
Mechanical	19	Velocities	4
Accelerations	9	Attitudes	2

MEASUREMENTS BY ENGINEERING ACTIVITY

Aerodynamic	57		
Propulsion	49	Structural	11
Controls	25	Instrumentation	5
Electronic	13	Electrical	3

Figure 3 and 4

radar and Doppler tracking techniques will be used to determine the trajectory and velocity. These are extremely important items in the success of the over-all mission, and must be checked very accurately. The electronic components and systems used in tracking must perform at maximum capacity.

We depend on tracking data also for range safety purposes, and failure of the equipment could mean the loss of the entire mission. To this end, we have an obligation to ensure that commercially procured equipment is fully qualified in every way to produce peak performance.

What makes all our problems even tougher is that the environmental conditions to be experienced by the Vanguard are extremely rugged and in some cases unknown. The vehicle will accelerate to the fastest velocity ever attained by a man-made object—18,000 miles per hour. It will fly from the sea-level launching site to the vacuum of outer space, encountering wide changes of air pressure, temperature, and aerodynamic friction along t way. Little is known about conditio on the borderline of space; that is w we are launching a satellite in the fi place.

The internal instrumentation syste of the Vanguard test vehicles w change from one vehicle to anoth with regard to the number and ty of measurements as the test progra progresses. But the basic system w remain the same (Figure 5). It is pro ably very similar to the basic syste used in most other rocket and missi test programs.

Transducers are used—where nece sary — to transform the functions be measured into suitable electric signals. These signals are then used modulate a telemetering transmitte which transmits the data to a grou receiving station. Here the signal decoded and recorded in analog for Some of the data is displayed in re time and is monitored as the flig progresses.

Three types of telemetering syster will be used to transmit data: t PWM/FM, PPM/AM, and FM/F systems (Figure 6). Each has its ow particular merits. The PWM/FM a PPM/AM systems use data samplin methods, or time multiplexing of t various data channels.

The FM/FM system uses frequen multiplexing to provide continuo transmission on each channel. Some the PPM/AM channels are further su commutated to increase the total nu ber of available data channels, accor

(*Continued on page* 36)

BLOCK DIAGRAM OF INSTRUMENTATION SYSTEM

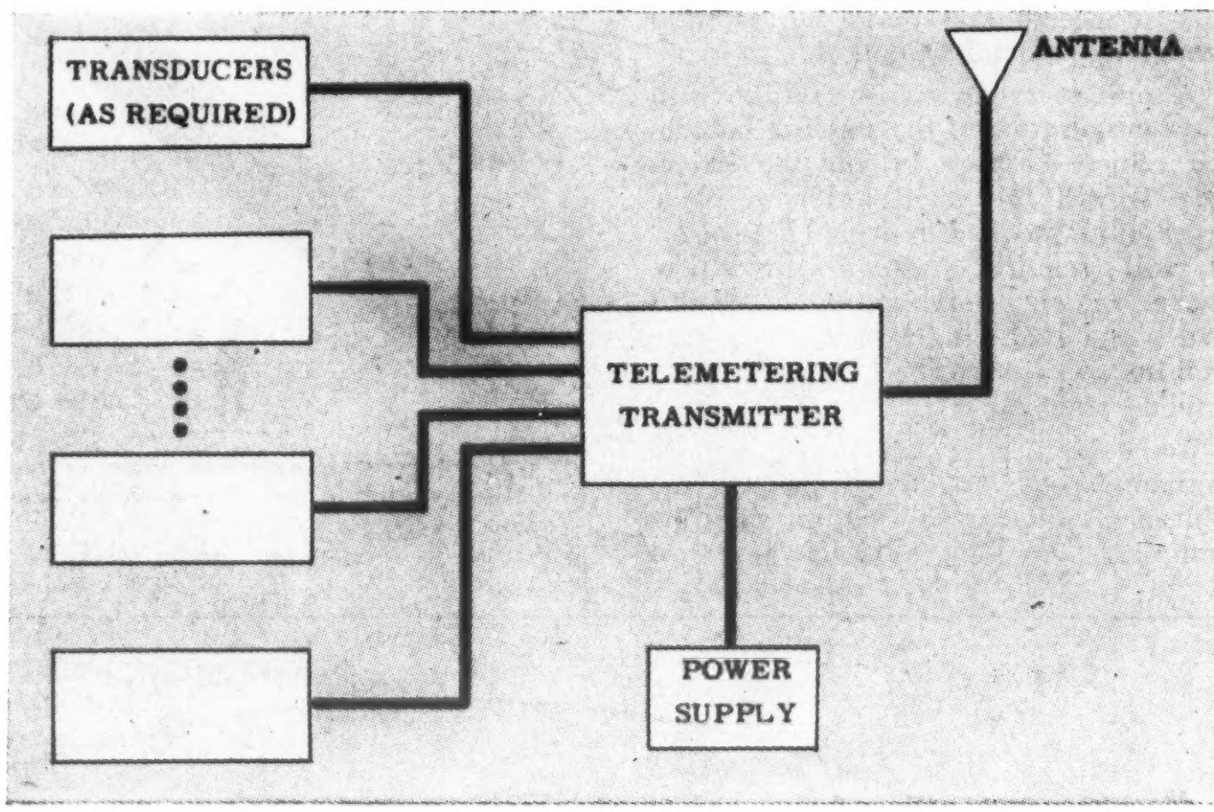


Figure 5

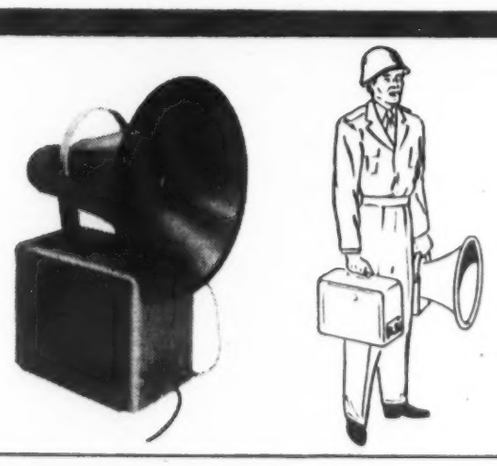
TYPES OF TELEMETERING SYSTEMS

Designation	No. of Data Channels	Sampling Rate Per Channel
PWM/FM (Pulse-Width Modulation)	43	20 Samples Per Second
PPM/AM (Pulse Position Modulation)	15	312.5 Samples Per Secon
FM/FM (Frequency Modulation)	12	Continuous

Figure 6

PORTA-KALL

portable public address system



- ☆ POWERFUL . . 13-watt output
- ☆ BATTERY OPERATED . . 6.3 volt (also available in 110v AC-powered unit
- ☆ ALL STEEL . . Reinforced welded "weatherized" construction . . hammertone finish
- ☆ VERSATILE . . Ideal for ship-to-shore, rescue work, troop command, or wherever self-contained powerful voice amplification is required

For Complete Information Write To:

J. M. LOGE SOUND ENGINEERS
2171 West Washington Boulevard
Los Angeles 18, California

along the
t conditions
that is why
e in the first

ation system
ehicles will
to another
er and type
est program
system will
). It is prob-
basic system
and missile

where neces-
functions to
e electrical
then used to
transmitter,
to a ground
e signal is
nalog form.
ayed in real
s the flight

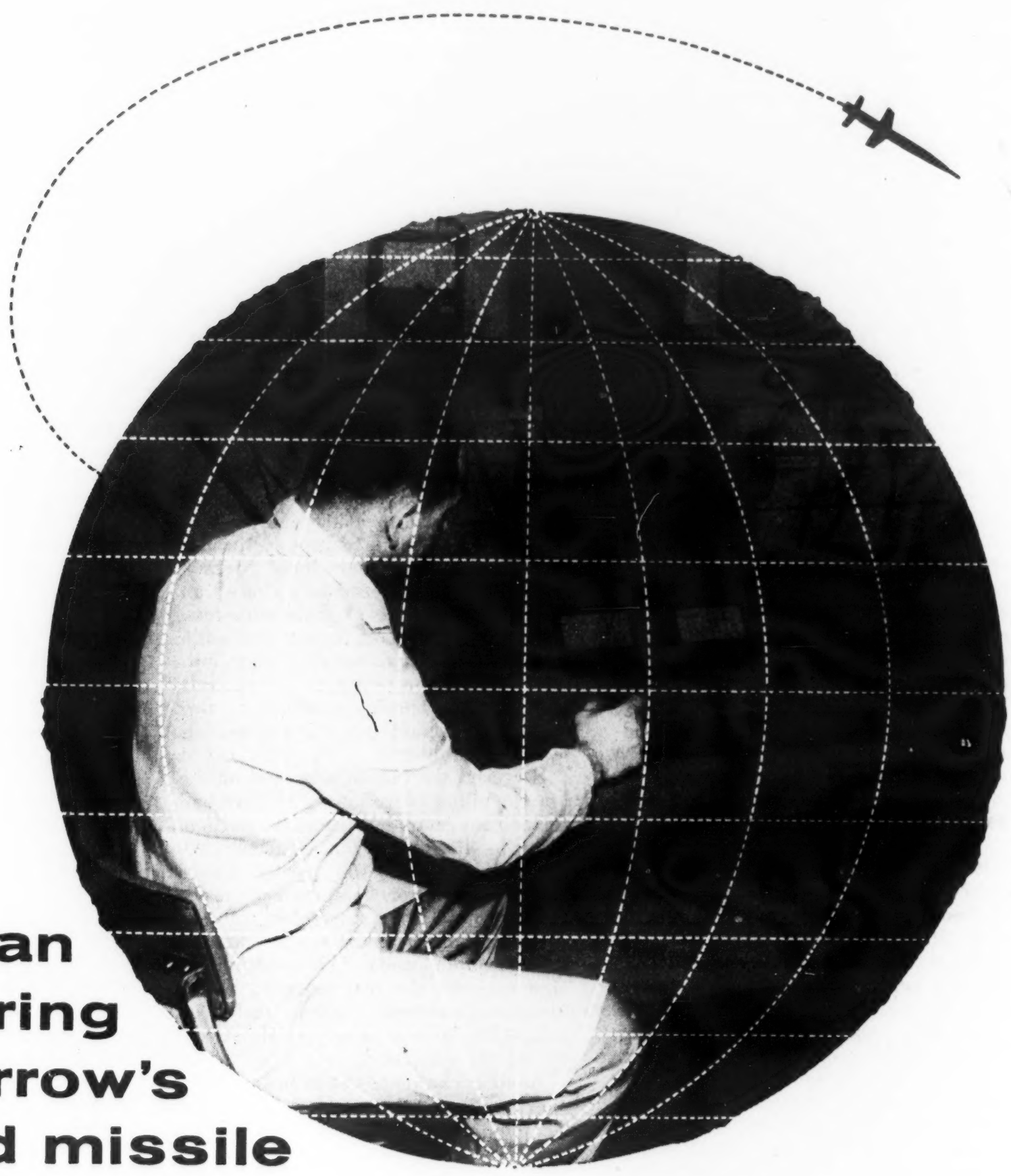
ring systems
t data: the
nd FM/FM
has its own
M/FM and
ta sampling
xing of the

es frequency
continuous
nel. Some of
further sub-
e total num-
nels, accord-
36)

NTENNA

g Rate
hannel
er Second
s Per Second

EMBER, 1957



This man is steering tomorrow's guided missile

His uniform is a laboratory coat, his cockpit a dust-free room with carefully controlled temperature and humidity. He's a skilled General Mills gyro technician—as much a part of the defense of his country as the jet pilot. Results from his work, and from work in other R & D labs, assure us that tomorrow's guided missiles will be even more accurate than today's. ¶ At the Mechanical Division of General Mills, the gyro lab is part of a talented, well equipped guidance and navigation systems development group. The group also includes top men and facilities in infrared, microwaves, electronic and mechanical design, and overall systems engineering. We team these men and facilities with a complete precision production plant to handle systems, sub-systems and major assembly problems for the world's most exacting customers. Possibly you too can benefit from our capabilities.

WE'D LIKE TO TELL YOU MORE

Send for facts about our unusual skills and how other companies use them in defense weapons production. Write to Mechanical Div., General Mills, Dept. SG9, 1620 Central Ave. N. E., Minneapolis 13, Minn.

MECHANICAL DIVISION

Creative Research and Development • Precision Engineering and Production

General Mills

ing to the needs of the particular vehicle. The arrangement is approximately six channels with subcommutation and nine continuous channels without.

The PPM/AM system was developed by the Naval Research Laboratory and has been used successfully for a number of years in the Martin Viking and the Aerobee programs. It has the advantage of being able to handle large quantities of data at low frequency response rates. The PWM/FM system has also been proven in rocket and missile work, and can handle slow response data. The FM/FM system is the standard RDB telemetering system, and is the prime range system at the Air Force Missile Testing Center, where the Vanguard vehicles will be launched. Its main function on the Vanguard program will be in handling high-frequency data inputs.

The telemetering systems indicate to a great extent the type of transducers or end instruments which will make the measurements we are seeking. In most cases, the telemetering system requires a signal input in the range of zero to five volts. Because of this, we are using potentiometric-type sensing elements wherever we can. Thermocouples, strain gauges, and inductance pickup are avoided whenever possible because they require added circuitry, black boxes, and the associated headaches that go with converting these signals to a usable voltage. In addition, signal converters take up too much valuable space and weight.

The Vanguard program has not been without its instrumentation problems. Past experience on the Viking rocket helped us to anticipate many of the difficulties we would encounter, but new problems peculiar to the Vanguard mission remained to be solved. Instruments have to perform under almost impossible environmental conditions. Temperature ranges from −300° to +1500°F will be encountered in many areas. Some instruments and equipment will be in contact with liquids and gases corrosive enough to etch or even destroy most metals. And all the components will have to contend with ever-present acceleration, shock and vibration.

Perhaps the toughest problem we faced was measuring the temperatures and pressures of the second-stage propellants: white fuming nitric acid and unsymmetrical dimethyl hydrazine. We felt that if we could develop a transducer that could maintain a sustained operation in the highly-corrosive nitric acid, this same instrument would be satisfactory for use in the other propellants of the Vanguard.

Handling white fuming nitric acid has been a serious problem in the past. It will vigorously attack most metals; titanium, aluminum, and stainless steel show the greatest resistance. Both the acid and the hydrazine are highly toxic, incidentally, and present an explosion and fire hazard to the ground crew.

It was apparent that no available transducer would be completely satisfactory for correct measurements in these media, so a special development program was initiated with the Rham Instrument Company of New York. The instrument has been built, tested, and evaluated. It employs a bourdon tube sensing element constructed of 316 stainless steel alloy with special fittings and weldments. It also has a stainless steel fail-safe case for protection, in case the tube fails. No isolation diaphragms or isolation media of any type are used in any of these instruments; direct measurements is the feature throughout.

Rham has also developed an instrument to measure pressure in the decomposition products of hydrogen peroxide, in temperatures up to 500°F.

The necessity of making internal temperature measurements has also presented us with special difficulties. The temperatures involved range from −300°F, the approximate boiling point of liquid oxygen, to +300°. Major consideration was centered around the use of thermistors, rather than thermocouples, since thermistors have an electrical resistance variable with temperature. Thermocouples require additional equipment to amplify their low-level signals to voltages compatible with the telemetering equipment; this presents a weight penalty and serious technical problems.

However, the thermistors used on the Martin Viking were known to have had some leakage under pressure, particularly in liquid oxygen systems. We realized that what was needed was a sealed thermistor temperature probe which could be assembled into a threaded boss, similar to the standard thermocouple probe. The resulting design encloses the thermistor in a thin aluminum capsule, which makes it adaptable for use in any of the media previously discussed.

Another challenge to our instrumentation requirements was the measurement of temperatures on the skin of the nose cone, which is subjected to severe aerodynamic heating. Again, the use of thermocouples was ruled out, for the reasons already mentioned. Similar measurements had been made on other rockets, possibly at lower skin temperatures, using the technique of cementing a wire grid to the inside surface of the skin. The wire grid or gauge has an electrical resistance that is a function of its temperature. This relationship is used to develop an electrical signal that is a measure of the temperature.

There were several obstacles to adapting this technique for the Vanguard vehicle. One was that the cements previously used had a maximum usable temperature of about 600 to 900°F, which is not adequate for some of the Vanguard measurements. Even at these temperatures, the cements tended to become brittle and flaky.

Also, all the known cementing processes required curing at an elevate temperature, and to do this withou depositing an oxide coating on the ski material would have required a specia oven capable of maintaining an at mosphere of inert gas. Finally, it wa found that the Vanguard skin material could not be held at this high curin temperature for the required lengt of time without being seriously warped

To solve the problem, then, w developed gauges of platinum allo wire grids fused to postage-stamp size squares of metal approximately one mi thick. These foil squares are then spot welded to the skin surface, eliminatin the need for cementing and curing.

With the exception of some of th more unusual measurements I hav discussed, the instrumentation syste for the Vanguard vehicle is not unlik that found in any other missile o rocket program. Our goal has been t use conventional techniques and prove equipment wherever possible and t improve on their quality rather tha jump into new methods and technique where results would be somewhat doubt ful. We believe that in some smal way we have contributed to the stat of the art in flight test instrumentation and in maintaining communications with a space vehicle.

We are only scratching the surface of space exploration, yet we are pushing to the limits of our existing equipment. Future satellites and space vehicles offer us all the greatest challenge o our lives. In any future venture, as in the present one, electronic and communication techniques will determine the success or the failure of the mission.

The time is drawing near; and when you stop and think of the time, money, energy, and facilities that are being put in a program of this magnitude, you might stop and ask — Why do we want an artificial satellite at all?

If you require specific justification for this endeavor, there are many particular results which are of immediate practical value. For example, expected data on the physical characteristics of the upper atmosphere, pressure temperature, and density will be required for future high speed, high altitude airplanes and missile designs. Triangulation measurements employing a satellite will permit more and exact determination of the size of the earth and of relative location of the land masses. In addition, more complete information on solar radiation, cosmic ray intensity, weather and magnetic phenomena undoubtedly will be of great value to the meteorologist.

However, all of the above data relate to the obtainment of short range objectives. The true significance of the project is that we have accepted the challenge to create something never before seen by man. Something to be used for the advancement of mankind by extending our knowledge of our environment. We have taken the first step in the exploration and conquest of outer space.

an elevated
his without
on the skin
d a special
ng an at-
lly, it was
n materials
igh curing
red length
sly warped.
then, we
num alloy
stamp sized
ely one mil
then spot-
eliminating
curing.
me of the
ts I have
ion system
not unlike
missile or
as been to
and proven
le and to
ather than
techniques
what doubt-
ome small
the state
umentation
nunications

he surface
re pushing
equipment.
e vehicles
allenge of
ture, as in
and com-
determine
he mission.
and when
me, money,
are being
magnitude.
Why do we
at all?
ustification
are many
of immedi-
ample, ex-
character-
e, pressure
will be
peed, high
le designs.
employing
and exact
the earth
the land
complete
on, cosmic
magnetic
ill be of
gist.
data relate
range ob-
ce of the
cepted the
ing never
ning to be
f mankind
ge of our
n the first
conquest

— —

MBER, 1957

SPLIT-SECOND MISSILE CONTROL AT 15,000 MILES PER HOUR

BURROUGHS GROUND AND AIRBORNE COMPUTATION "THINKS" FAR AHEAD OF SUPERSONIC MISSILES

Eye-defying speeds characterize today's ballistic missiles, and their effectiveness depends on accurate guidance.

That means electronic computation—and *telemetering*, which now keeps ground guidance control instantaneously informed of what's going on within and around the missile in flight: directional variances, atmospheric density, propulsion performance and so on.

Electronic computation, telemetering, high-speed read-out devices for airborne control or ground missile guidance . . . all are identified with Burroughs in today's vital defense contracts. From initial research to actual installation and field services Burroughs participation extends to instrumentation, control systems, communications and other facets of electronic computation.

We welcome inquiries regarding projects in any and all areas of our proved competence. Write, call or wire Burroughs Corporation, Defense Contracts Organization, Detroit 32, Michigan. Or Burroughs Defense District Offices: Paoli, Pa. • Dayton, Ohio, 3898 Linden Ave. • Encino, Calif., 17071 Ventura Blvd. • Washington, D.C., 1145 Nineteenth Street N.W.

BURROUGHS CORPORATION

THE FOREMOST NAME IN COMPUTATION

Rapid Fault Elimination In Complex Electronic Systems

by John F. Scully, Special Projects Manager, Monroe Calculating Machine Co.

A 1957 AFCEA Convention Presentation

★ ★ ★

THE PURPOSE OF THIS ARTICLE IS TO discuss some aspects of the maintenance problem which affect major electronic systems in industry and the military and some work that the Monroe Calculating Machine Company has been doing to reduce the burden of maintenance of such systems over the last few years.

The problem is essentially generated in modern times by the inherent complexity and size of the large systems which we need to perform modern day functions in warfare and industry. The very nature of the problems themselves requires that the systems be complex. Try as we will to minimize the number of elements in these systems, larger and larger systems are found necessary every day. Not only does the size increase in terms of number of elements, but also the complexity of the interrelationships of the elements. To comprehend in detail a modern computer with perhaps 15 or 20 thousand logical elements is an almost impossible task—impossible, that is, to all except those few who are very expert on that particular equipment — for example, the people who designed and built it. As the complexity increases, the need for keeping the equipment in operation increases even more drastically.

One result of this complexity is that sound maintenance programs and research and development efforts are badly hampered. Also, the operational reliability of these large equipments into which we put so much faith in modern warfare is considerably lowered over what we might expect of them because, while they may do an ideal job when they are working, they may often fail to work. Also, the training and establishment of necessary personnel, particularly in the military, to keep the equipment in operation, becomes very difficult because you approach the time where a man needs two years to learn how to trouble shoot the equipment, and by then he is often lured away from the Service.

For the purposes of this article, we think not in terms of a missile whose reliability is gauged by the probability that it will make a kill when it is dispatched, but rather in terms of a system which is in constant use; and, if it fails, can be repaired and placed in operation.

Now, what is the reliability of such a system? We might very well define it in terms of the operational efficiency of the unit. This is made up in large part of two elements: (1) the mean time-to-failure of the system, that is, the number of hours on the average you can expect the equipment to operate before failure is encountered; (2) the time required after failure to restore the system to useful operation. Is it a minute, fifteen minutes, two hours, a day, a week, or may you never find the trouble at all? Reliability will be defined, then, as the efficiency of the equipment as measured by the ratio of the time that the machine will do the job to the total operational time desired. If it's useful all the time, it has an efficiency of unity; if it is never useful, it has an efficiency of zero.

When one builds an electronic system, he strives to achieve the utmost in terms of reliability in components and engineering. Assuming that one has done the best he can in this respect, we establish, for a given equipment, a mean time-to-failure which is a function of the design of the equipment and its environment. Not much can be done about the design after the equipment is in the field. The environment may be a product of Nature, and not much can be done about that either. Then the efficiency depends on the ability to repair a defect when a defect occurs.

What can be done to minimize the down-time? Since machines are assuming more and more the duties of the human, operation-wise, and becoming capable of doing operations automatically, we might inquire into the ability of machines to conduct their own maintenance, which after all, is normally a human problem. What is involved in its maintenance? Errors must be detected when they occur; the source of the difficulty must be located; the defective components must be replaced; the system must be cleared of error and caused to resume its job.

All of these aspects of system performance can be made automatic by suitable means, except, perhaps, that of component replacement, which does not seem practical at this time. Once a human knows what plug-in unit or chassis to replace, the problem of replacing it becomes a small part of the over-all maintenance work — most of which in large systems today, lies in the location of the defective component rather than its replacement. This was not always true. We remember some radars during the last war in which finding the trouble was not nearly so difficult as getting underneath various sub-chassis to remove the part that was at fault.

In 1953, a prototype automatic fault location means was brought to fruition in the laboratory; it was called MAID —short for Monroe Automatic Internal Diagnois. The MAID monitors, detects and locates troubles in digital equipment automatically, and since the experimental development in 1953, the system has been put into several full-scale digital calculators, the first one of which was delivered to the Air Force in 1955. Several others embodying the system have been delivered since.

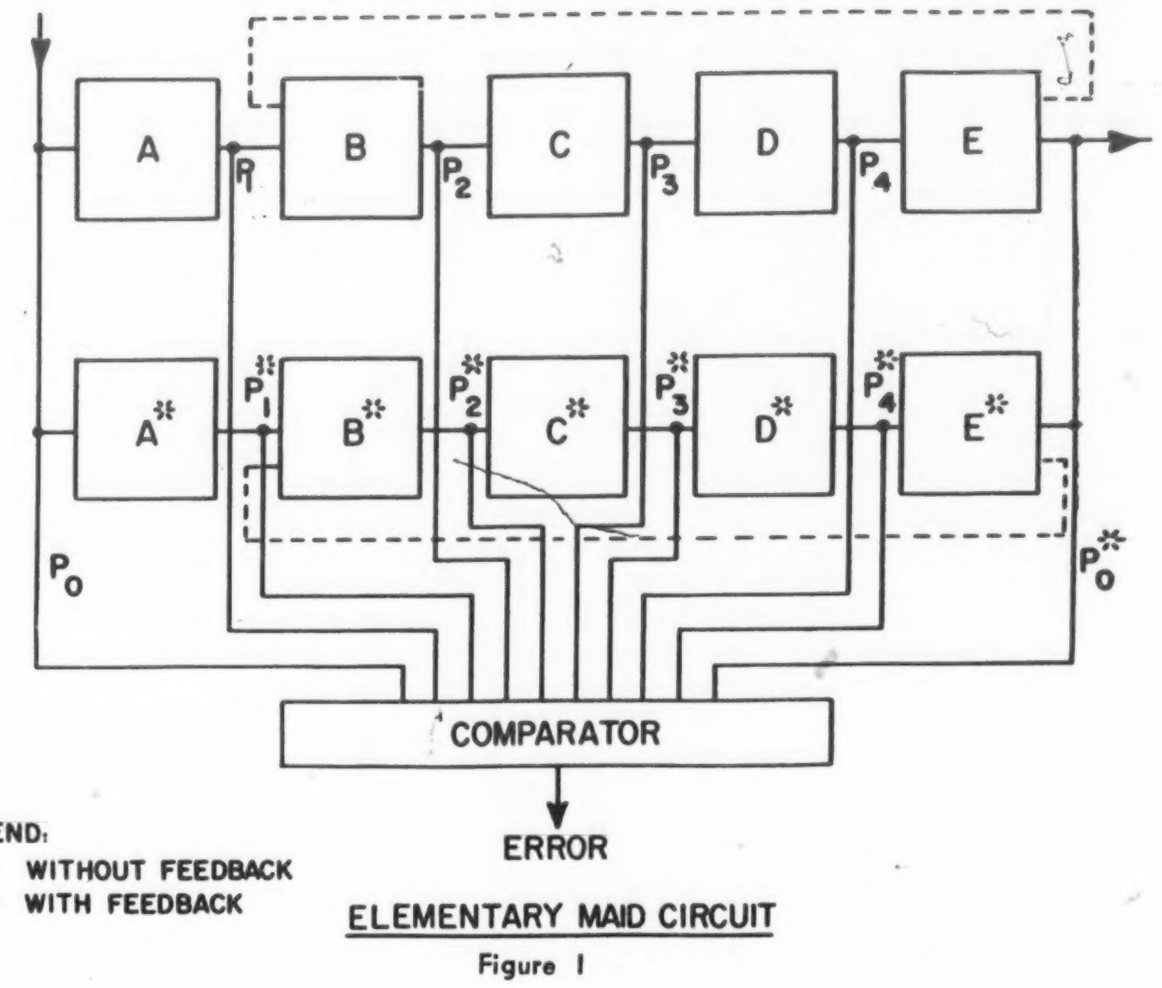
Without too much technical detail, we may discuss the basis of the system briefly before discussing the philosophy of it and what it can do.

One can think of all the points of an equipment as a set which, when the equipment is performing properly, consists only of points of proper operation. When a trouble condition occurs, some

subset of points of that system is also going to be in trouble. If we knew what was going on at every point of the equipment, then we would know which subset was defective. Further, if a trouble condition exists in an equipment, there must be a group of points which are in trouble at the *earliest time*. Obviously, the trouble is going to show up in these points before others, which are dependent on it in time. The problem then may be defined as one of finding, of all the points that show trouble, that set of points which shows trouble at the earliest time and from that set of points, then, selecting the one which is least dependent upon the others.

The problem is complicated, of course, if there are feedback loops because one may start anywhere and the trouble will propagate around the entire loop, so that seemingly one could not tell which point shows the fault earliest. In any such feedback loop, there is delay. Therefore, it takes time for the trouble to get around the loop. The delay time may be in microseconds, but it is nevertheless detectable.

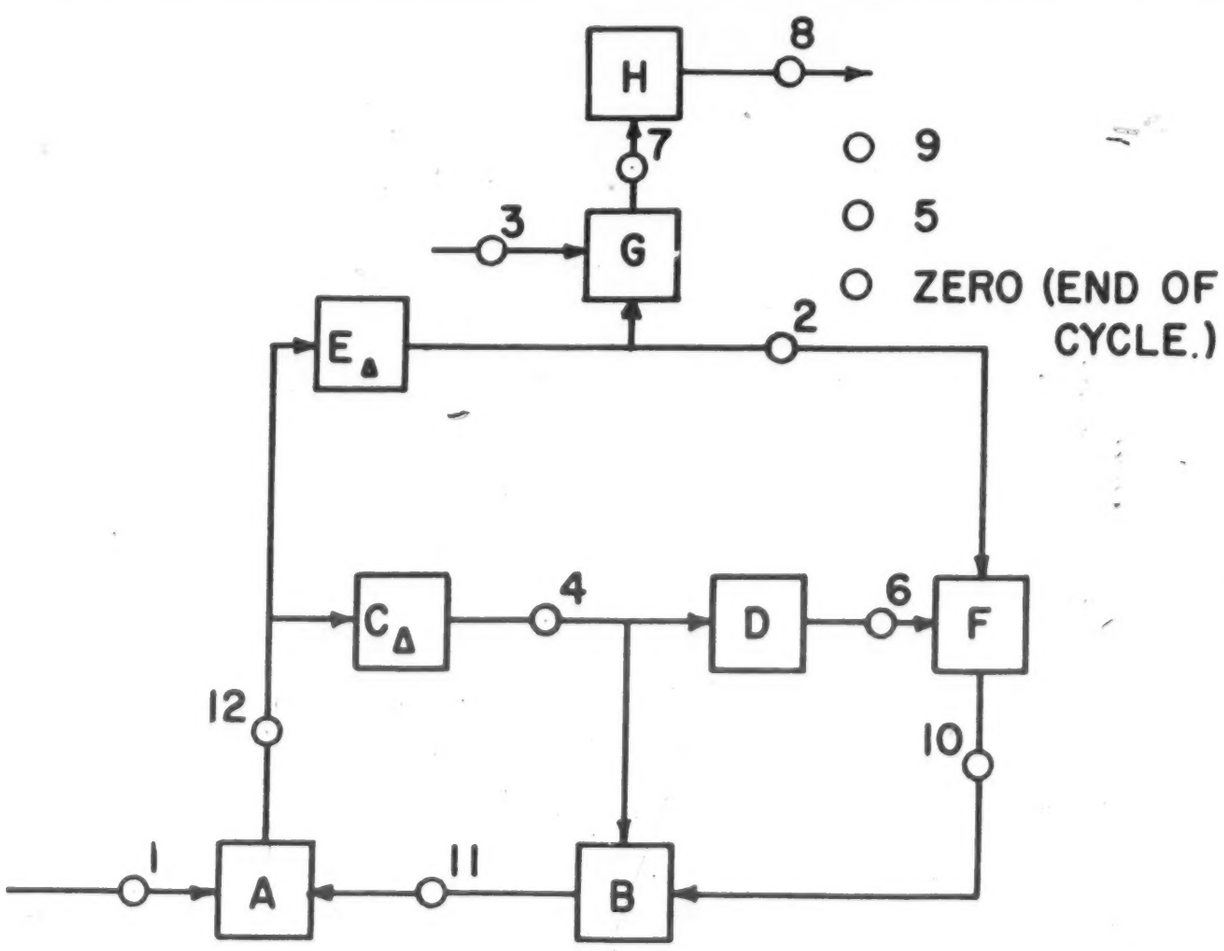
In a very small system, one means of finding out if there is trouble in the equipment is to have two such equipments doing the identical job, namely, the set without the asterisk and the set with the asterisk (Figure 1). If there were trouble in Box A and the system were a straight feed-through proposition, then that trouble would be reflected in Boxes B, C, D and E. Further, if one monitors such pairs of points in a comparator and picks up the error, one can scan backwards from the output to the input, and that point showing trouble which is nearest the input is the source of the trouble since the others are dependent upon it.



ELEMENTARY MAID CIRCUIT

Figure 1

As is usually true with a television set or radio receiver where one goes from stage-to-stage, it is not difficult to locate the earliest point. Figure 2 shows a situation which is, perhaps, a little more typical of a complex system such as a digital computer. In this case one has feedback loops, so that the human with an oscilloscope, trying to find out which stage is the source of the trouble, is in difficulty because the trouble can appear everywhere in the loops. However, electronic circuits can readily be made to detect which point has the earliest time of occurrence because they can measure in microseconds, and the human eye cannot.



BASIC MAID OPERATION

Figure 2

If an electronic monitor in the MAID finds that trouble occurs at say, point 12 of the unit shown in Figure 2, it can then scan back to point 11. If the trouble occurs at point 11, the MAID system notes that point 11 is in trouble, re-cycles the system and then takes a look at point 10, comparing the performance with that of point 11, so far as error of operation is concerned. Now a defect which lies in Box B in the diagram will show trouble at points 11 and 12, but not at point 10. Therefore, the monitor unit in stepping backwards to points 10, 9, 8, 7, 6, 5, etc., ultimately going back to zero, will find no trouble which is earlier than point 11, either in time or in dependency. Consequently, the unit which marks point 11 as being in difficulty is in essence saying that Box B was the source of the trouble. The same is true of any other box selected.

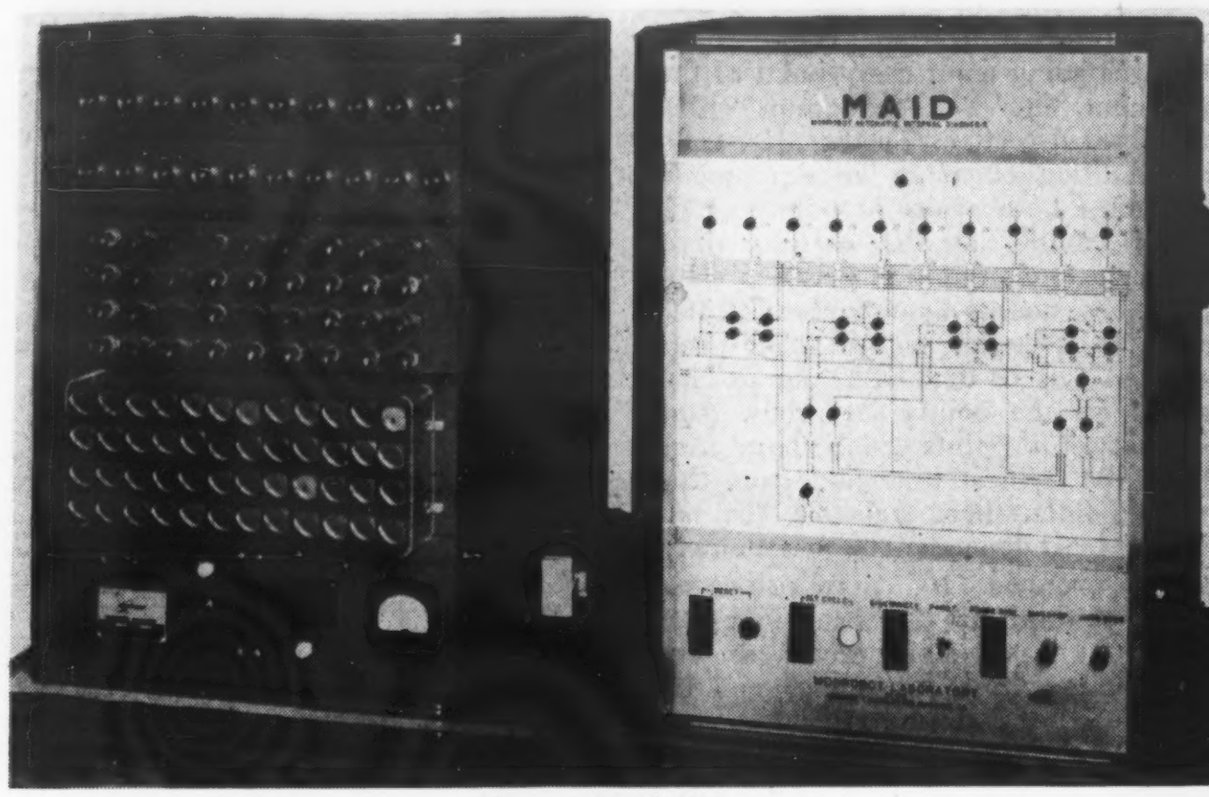
Duality has been mentioned as one means by which one can detect proper performance of a point. The first MAID system made use of the redundancy available in duality not only to detect errors, but also to step back and use that duality to locate automatically the source of the error. One does not always, of course, have duality; other approaches to the problem will be discussed later.

What has been the result of actual use of this system in the field? In the equipment delivered to the Air Force which contained on the order of 1500 vacuum tubes and some 6000 germanium diodes, the down-time on that equipment was reduced to a value perhaps 25% of what it was without the automatic diagnosis system. A greater down-time reduction was not achieved for two reasons. One is that in any system,

troubles occur which are not remediable merely by replacing a component, as, for example, broken wires inside of cables, or a stray piece of dust getting between the contacts of a switch. The other reason is that not quite as much was known about the application of diagnosis systems to equipments then as today. This equipment was the first one to which the principle had been applied. Several computers have been delivered to the field since and similar results, namely, about 25% of normal down-time has been achieved with the diagnosis system. This is achieved without any change in the mean time-to-failure which is a function of the components and the design of the system.

Other advantages of the MAID system and automatic maintenance are that a reduction takes place in maintenance skill required. That is, one does not need people of so high a caliber to locate the faults.

In production trouble shooting where one always has more than one of a kind of a unit, duality is inherent. One may not have it where machines are in different locations, but certainly while they're in the factory, any two together are dual equipments and the dual MAID system can be applied. Also, training on equipments becomes much easier because with the use of the automatic diagnosis unit, the trainee is told by the machine much about the functioning of the system. Of course, as with all positive monitoring systems,



Monroe Maid Unit

you have the security of knowing whether or not at any given moment the system is in proper functioning order.

So much for the past and what has been achieved with the system to date. What about the present and the future? The early systems used dual equipments as the means of obtaining knowledge of proper operation of each of the points in the equipment. Where one has a dual system, it is still, perhaps, as good a means as any, because the equipment required for the diagnosis is exceedingly simple. The early system was applied to digital computers where the states of the system changed discreetly at clock time intervals, and it was natural for Monroe to apply it to such systems because that was our major electronic business. We do believe, however, that the same basic principles can be extended to large equipments of other kinds, such as radars even though they may not be digital. Nothing in the philosophy of the system requires a discreet clock system.

Several improvements have been realized since the delivery of the first prototype MAID unit. In the first place, in the dual system, where trouble location used to require a matter of seconds (or in very difficult cases, minutes) the scanning means has been improved so that today, on medium speed computers, one can locate the source of the trouble within one clock interval. On a recent equipment, that interval is 8 microseconds; you don't have to wait minutes any longer on that equipment when trouble occurs. An intermittent failure can then be located immediately.

Quite a bit of work has been done in applying automatic diagnosis to singular electronic complexes, that is, those having only one set of circuits. Here, a different criterion of proper performance is used—one which is applicable to the system in question and does not require the use of dual circuits.

Thirdly, much has been done in the field of pre-cognition, that is, error-free marginal checking while actually operating the equipment so that it is known in advance whether or not the unit is marginal without forcing it to the point of failure. In this case, you have the option of continuing normal operation and removing the potential trouble at some later date, perhaps, during periodic maintenance.

Editor's Note: The successful experimental MAID unit, shown above, was on display and demonstrated at the Monroe exhibit booth during the 1957 AFCEA Convention.

TELEPHONE AND TELEGRAPH EQUIPMENT

Radio Engineering Products is currently producing a number of types of equipment, electrically and mechanically interchangeable with standard Bell System apparatus.

CARRIER-TELEPHONE EQUIPMENT

C5 Carrier-Telephone Terminal (J68756). A kit for adding a fourth toll-grade channel to existing C systems is available. • C1 Carrier-Telephone Repeater (J68757) • 121A C Carrier Line Filter • H Carrier Line Filter (X66217C).

CARRIER-TELEGRAPH EQUIPMENT

40C1 Carrier-Telegraph Channel Terminal (J70047C) • 140A1 Carrier Supply (J70036A1, etc.) • 40AC1 Carrier-Telegraph Terminal.

VOICE-FREQUENCY EQUIPMENT

V1 Telephone Repeater (J68368F) • Power Supply (J68638A1) • V1 Amplifiers (J68635E2 and J68635A2) • V3 Amplifier (J68649A) • V-F Ringers (J68602, etc.) • Four Wire Terminating Set (J68625G1) • 1C Volume Limiter (J68736C).

D-C TELEGRAPH EQUIPMENT

16B1 Telegraph Repeater (J70037B) • 10E1 Telegraph Repeater (J70021A) • 128B2 Teletypewriter Subscriber Set (J70027A).

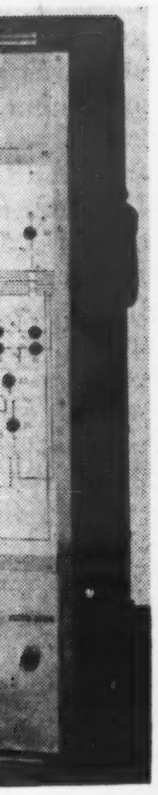
TEST EQUIPMENT

2A Toll Test Unit (X63699A) • 12B, 13A, 30A (J64030A) and 32A (J64032A) Transmission Measuring Sets • 111A2 Relay Test Panel (J66118E) • 118C2 Telegraph Transmission Measuring Set (J70069K) • 163A2 Test Unit (J70045B) • 163C1 Test Unit (J70045D).

COMPONENTS AND ACCESSORIES

255A and 209FG Polar Relays • Repeating and Retard Coils, several types • 184, 185, 230A and 230B Jack Mountings.

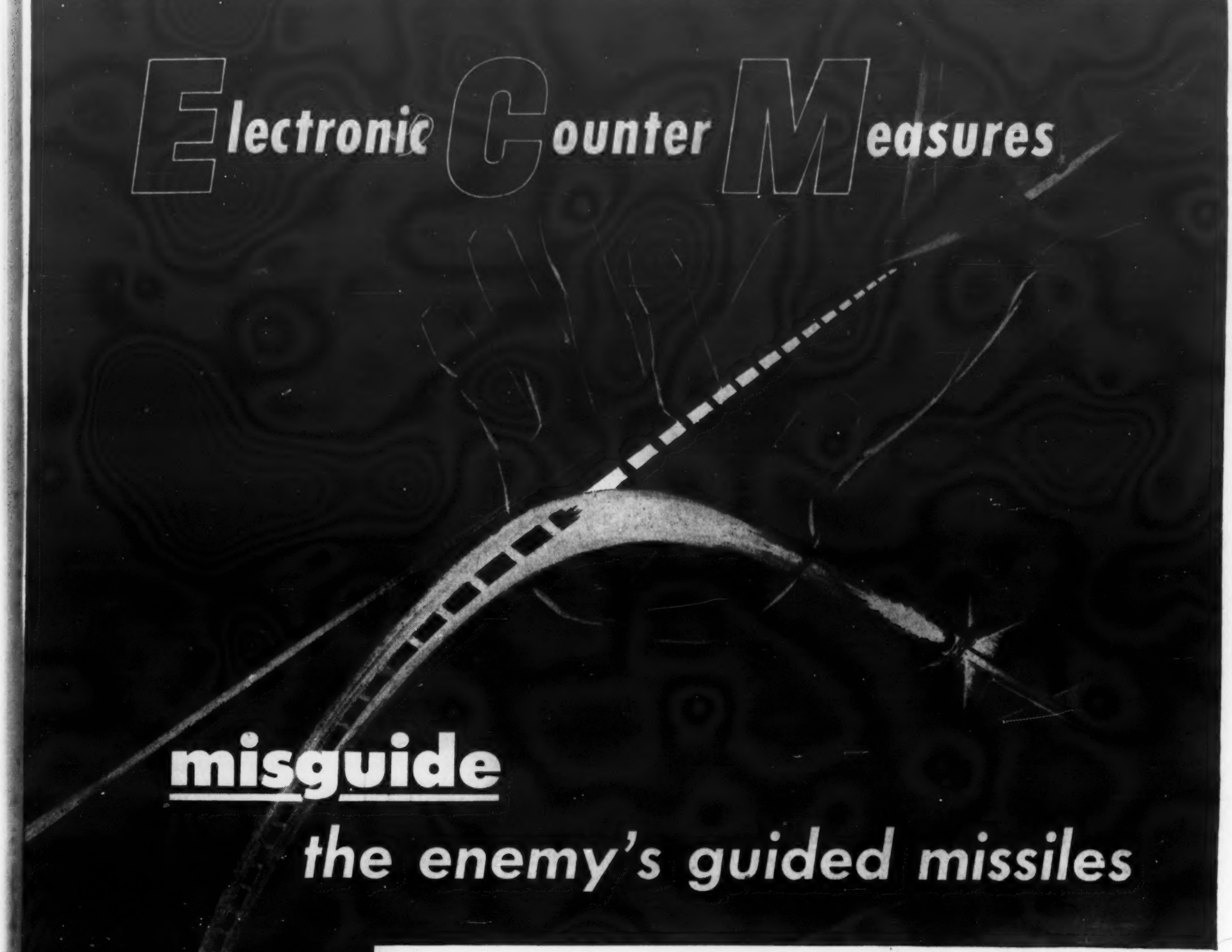
RADIO ENGINEERING PRODUCTS
1080 UNIVERSITY ST., MONTREAL 3, CANADA
TELEPHONE UNiversity 6-6887
CABLES RADENPRO MONTREAL



vas applied
ne states of
ly at clock
natural for
systems be-
electronic
wever, that
can be ex-
s of other
hough they
in the phi-
ires a dis-

e been real-
e first pro-
st place, in
ble location
econds (or,
nutes) the
mproved so
computers,
the trouble
On a recent
8 microsec-
ait minutes
ment when
tent failure
ately.
een done in
is to singu-
at is, those
ts. Here, a
er perform-
pplicable to
does not re-
s.
done in the
s, error-free
ctually op-
that it is
or not the
orcing it to
s case, you
ing normal
e potential
e, perhaps,
.
sful experi-
above, was
ted at the
g the 1957

Electronic Counter Measures



misguide

the enemy's guided missiles

Admiral® develops airborne *ECM*

You can't count on shooting down a guided missile. The only effective defense against it is some form of Electronic Counter Measures...devices that deceive or destroy enemy missiles short of their targets.

Admiral has taken the lead in furthering the high priority program to develop ECM. Advanced ECM developments now in progress at Admiral will serve many defense purposes. Resulting equipments will be carried by aircraft for protection in hostile territory. At ground installations, ECM will confuse enemy missiles.

Inquiries are invited regarding Admiral's capabilities in ECM and other forms of military electronics.

LOOK TO *Admiral* FOR
- **RESEARCH**
- **DEVELOPMENT**
- **PRODUCTION**

IN THE FIELDS OF:
MILITARY TELEVISION
COMMUNICATIONS UHF AND VHF
ELECTRONIC COUNTER MEASURES
RADIAC • RADAR • TELEMETERING
DISTANCE MEASURING
RADAR BEACONS AND IFF
CODERS & DECODERS
MISSILE GUIDANCE
CONSTANT DELAY LINES
TEST EQUIPMENT

ENGINEERS. The wide scope of work in progress at Admiral creates challenging opportunities in the field of your choice. Write Director of Engineering and Research, Admiral Corporation, Chicago 47, Illinois.

Admiral®
CORPORATION
CHICAGO 47, ILLINOIS
GOVERNMENT LABORATORIES DIVISION

SCATTER PROPAGATION

Part II

U. S. Air Force Presentation

By

Colonel Robert C. Sears, USAF

Synopsis, Part I

In the August issue, RAdm. J. N. Wenger, as panel moderator, introduced the subject of Scatter Propagation by reviewing the principles and phenomena involved, and stressed the great importance of the new techniques of ionospheric and tropospheric scatter to the Military Services.

Colonel W. A. Ross, representing the Army Signal Corps, discussed the information which has been and is being obtained from the ionospheric scatter system in Alaska and the tropospheric scatter system between Washington and Fort Monroe, Va. He told of the amazing progress that is being made at the U. S. Army Signal Engineering Labs which have successfully demonstrated communications over a path in excess of 1900 miles. For tactical operations, he stated, further evaluation is required on presently developed equipment.

Captain W. A. Ellis, representative of the U. S. Navy, discussed the difficulties confronted in ship to shore and ship to ship communication circuits due to the great size and weight of scatter antennas, and to the focalization problem resulting from pitching ships. He stated that tests have determined that tropospheric and meteor burst modes of communication may be feasible for Navy application.

As you know, the Air Force has been using both ionospheric and tropospheric scatter for some time. Our selection of these two modes of communications was based primarily on our requirement for highly reliable communications to support offensive and defense air operations in which both sides enjoy a 600 mph bomber capability. The problem of reliability was most serious in the high northern latitudes where both high frequency and low frequency circuits were often blacked out by auroral disturbances. These outages were particularly serious because of the important role the Arctic plays in strategic air operations between the United States and Russia. I would like to trace briefly the history of the Air Forces' experiences with the scatter techniques as a solution to this Arctic communications problem.

Shortly after the first successful tests of long range VHF propagation in January 1951, the National Bureau of Standards was requested by the Air Force to investigate the possibilities of employing long range VHF propagation operationally to meet urgent communications requirements to Laborador and Greenland, where other means of radio communication were difficult and unreliable. A survey was conducted by Bailey and Bateman, then of the National Bureau of Standards, accompanied by an Air Force officer. The survey was to ascertain the feasibility of providing long range VHF circuits between Goose Air Base in Laborador and Thule Air Base in Greenland. As a result of the recommendations which stemmed from the survey, the Air Force asked the National Bureau of Standards to establish a simplex test circuit to transmit from Goose Bay to Sondestrom at the earliest possible date. This path was selected for three principle reasons: First, the path length of approximately 1000 statute miles was thought to be nearly optimum for this mode of propagation and was substantially longer than previously tested paths; second, the mid point of the path was very near the region of maximum auroral occurrence; and third, the path connected two important Air Force bases between which serious difficulties were being experienced with other means of communication. This circuit was established with an operating frequency of approximately 50 megacycles which was essentially the frequency that was used on other VHF experimental circuits, therefore performance data could be readily compared. Vertical polarization was used on this test circuit since the only other existing long range VHF experimental circuits were employing horizontal polarization and little was known experimentally about vertical polarization. The transmitter was a modified AN/FRT-6 with an output of 40 KW. The antenna was a four element vertical half rhombic. The receiving antennas were 45 degree corners with collinear elements in space diversity. The tests were started in the latter part of January 1952. In October 1952 the half rhombics were replaced with vertical full rhombics as the half rhombic antenna gain was adversely affected by changes in the reflecting plane with snow, rain and dry weather. Single channel teletype messages were transmitted over this circuit in March 1952 and four channel time-division multiplex teletype traffic was initiated in January 1953. The Goose Bay to Sondestrom test facility continued in operation until December 1953. At this time the experimental facility was dismantled having been replaced by a new installation.

In May 1952, after a short evaluation of the test circuit, the decision was made to proceed with the installation of three VHF circuits linking the United States with Thule, via Goose Bay and Sondestrom. This early decision resulted from pressing operational requirements for reliable communication between these points. This phase of the program has been nicknamed "Bitter Sweet." The first objective of this program was to establish a single teletype channel. As a further objective the possibility of providing a reliable multichannel teletype service was to be investigated. Bitter Sweet was completed by November 1953 and the first two way tests were begun in December. Horizontal polarization was used throughout the system; due to the experience gained on the test circuit vertical polarization was abandoned. Full rhombics were thought to be the most desirable antennas, but at some sites the terrain was so rugged that large flat areas for rhombic construction could not be obtained. Horizontal corner reflector antennas were developed and used at these sites. Where the rhombics were used they were stacked to give additional gain. The corner reflectors were 60 degree with collinear arrays. The aperture dimensions are five wave-lengths across and three wavelengths high.

The Bitter Sweet circuit was supplemented by a program which was approved by the Joint Communications-Electronics Committee in December 1953. This program, which was nicknamed Fat Girl, was to provide for an extension of the Bitter Sweet circuit to the United Kingdom via Iceland, and for an additional link between Goose Bay and Narsarrsuak, Greenland. These circuits were scheduled for operation in December 1954. The equipment and antennas used were essentially the same as in the case of the Bitter Sweet circuit.

One link of the original Bitter Sweet circuit was known to be somewhat short for reliable propagation, but the link was implemented because of operational urgency. This short link was from Loring, Maine, to Goose Bay, a distance of about 570 statute miles. Recently the Loring Terminal was moved to Wachusett Reservoir near Worcester, Massachusetts, increasing the path length to about 920 miles. I will discuss this move later, because the facility at Wachusett incorporates some of the latest improvements in ionospheric scatter.

Ionospheric scatter is used for DEW Line rearward communication. There are five circuits in support of DEW Line with terminals in the United States and Alaska.

Ionospheric scatter is not always a perfect answer to long range communication. During 1954 the Air Force and the National Bureau of Standards conducted tests over a path from Newfoundland to the Azores, a distance of about 1440 statute miles. Evaluation of the results of these tests led to the decision that ionospheric scatter was not economically feasible over that path, primarily due to the transmitter power required. As the state of the art advances other circuit parameters may compensate for the increased power requirement and at that time extreme range

circuits may be economically implemented. Note should be taken that the circuit was technically possible, but the cost of installation and operation of higher powered transmitters is the factor that led to consideration of other methods of communication to meet the operational requirement.

In addition to the Air Force North Atlantic ionospheric scatter system which has been mentioned and the DEW Line rearward scatter circuits, the Air Force also operates an ionospheric scatter test circuit between Cedar Rapids, Iowa, and Scituate, Massachusetts. This circuit is used primarily to test modulation techniques. At the present time the Air Force is planning an additional test facility between Rome Air Force Base in New York and Eglin Air Force Base in Florida. This circuit will be used primarily to service test equipment designed for ionospheric scatter operation.

In the establishment of reliable communications both forms of scatter must be considered. It is fortunate that the tropospheric scatter distances and the ionospheric scatter distances supplement each other. In support of the air defense radar sites communicationswise, as has been pointed out, ionospheric scatter lends itself best for rearward communication. The distances between adjacent radar sites makes tropospheric scatter ideal for communication between them. The Air Force today operates approximately 150 tropospheric scatter terminals used in support of the Air Defense Mission.

Study and Development

On the 5th of December 1953, the Director of Communications U. S. Air Force initiated a staff study concerned with communications in support of the Laborador-Newfoundland Air Defense system. This study pointed out that high frequency and low frequency communication in the northeast area were inadequate to provide the reliability demanded for an air defense system. It recommended that communications support should consist of microwave and cable to give the reliability desired. The system was to have fifty stations of line of sight microwave. Equipment and construction programming were such that the lower half of the system, St. Johns to Goose Bay, was scheduled for completion in late 1955. No target date had been set for the completion of the upper half of the system, but the best estimates placed completion in late 1956. At the time of the staff study approximately fifteen and one half million dollars were available for the microwave and cable system. The total cost of the system was estimated to be about forty four million.

Tropospheric scatter was suggested in the study as being a technique which might bring the upper portion of the Pole Vault system into operation by late 1954, or two years previous to the date for microwave. Estimates made at that time indicated that a twelve channel tropospheric system would approximate five million dollars for the upper portion of the system. To expand the system to thirty-six channels the cost would be ten million. The big saving moneywise, as compared to microwave, was in the cost of construction: thirty-two million for the microwave system compared to two and one-half million for tropospheric scatter for the whole system.

The drastic savings in construction costs stem from the collocation of the tropospheric scatter buildings and the radar facility on the same site. With the reduction in the number of stations, the logistical support and personnel requirements were significantly reduced. In the Laborador-Newfoundland area these two factors are many times more vital economically than in the United States.

I should point out that the system proposed, that is tropospheric scatter, to replace microwave over the Pole Vault system was new and untried on an operational circuit. Experiments conducted by the National Bureau of Standards and by the Air Research and Development Command through Lincoln Laboratories and Bell Telephone Laboratories indicated that the *exact* degree of reliability and channel capacity could not be predicted accurately, but the concensus among the scientists was to the effect that reliable communication with minimum channel capacity could be expected. Further, the experimental data indicated that marginal propagation could be expected at times; but the data also indicated that high power and large antennas would compensate for the degradation of propagation. These large antennas and power amplifiers necessary to overcome the degradation of performance were not available and had to be developed, but this development was well within the state of the art. The use of tropospheric scatter offered advantages—operational as well as economic. We could have a system in being two years before a microwave system could be completed. The findings of the staff study pertaining to tropospheric were approved, and action was taken immediately to divert money from the microwave system to the development of the tropospheric scatter system. The result was the first operational tropospheric scatter system, installed by Bell Telephone Company of Canada—a reality in less than two years from the time the study was completed.

In Alaska the Army provides communications in areas of joint military and civil interest. While in the outlying areas the Air Force and CAA provide their own facilities. With expansion of the Air Defense Radar System in Alaska in 1951, the limited channel capacity of the Air Force system then in being was inadequate to provide the operational circuits necessary to support the expanded operation. Here again the rugged terrain and climate proved microwave or cable uneconomical and infeasible. In May 1954, as an indirect result of project Pole Vault, a study was submitted for the improvement and expansion of the Air Force circuits in Alaska using tropospheric scatter as the primary means for point-to-point communication. In December 1954, the Department of Defense approved a plan of implementation, and in January 1955, a contract was awarded to the Western Electric Company. The system was designed to serve all government and territorial agencies requirements for communication over the routes of the Air Defense circuits. An overload and future requirements capability of fifty percent was designed into the system. Contractual costs for equipment and installation are estimated at fifty-six million dollars; construction is estimated at forty-two and one-half million. The project, known as White Alice, is now underway and completion is scheduled in February 1958. White Alice comprises eight microwave links and twenty-three tropospheric scatter circuits.

The Air Force has recently tested an extreme range tropospheric scatter circuit in the Arctic, in this case a distance of 690 statute miles. This is the longest single hop attempted with tropospheric scatter for an operational circuit. The path loss tests just completed dictate that transmitter powers in the order of 50 KW and 120 foot paraboloids will be necessary for successful circuit operation. The frequency for this circuit is in the 400 megacycle range. Both space and polarization diversity will be used for the received signal.

Experiences and Techniques

It is appropriate at this time to look at some of the experiences we have had as a result of operation of the circuits that have been mentioned thus far. First let us consider the ionospheric scatter mode of propagation. The Air Force originally bought the ionospheric scatter mode to increase communication reliability thru the northern auroral zone. High frequency and low frequency operation did not give the reliability required. In fact when both of these techniques were available between the same two points, the ionospheric scatter mode gave better performance than HF and LF combined. Another factor worth mentioning is that when HF and LF circuits deteriorated due to propagation, the scatter signal was enhanced by the same phenomenon which adversely affected the HF and LF circuits. As has been mentioned the high sun spot number has increased our outages due to propagation difficulties, but when the ionospheric scatter circuits operate above the maximum useable frequency for F-layer propagation the reliability figure remains good. The over-all performance figures for the Bitter Sweet system are lower than they should be because of the short link from Goose Bay to Loring, Maine. This path has now been lengthened and a significant increase in system performance is expected.

The scientists tell us that for operation in the ionospheric scatter mode we must stay above the maximum useable frequency for F-layer propagation. As the MUF goes up this means that we must operate at a higher frequency. But operation at a higher frequency requires more power and thus is more expensive. In order to remain in the ionospheric scatter mode it now appears that two frequency operation will be necessary. The Air Force is investigating the possibility of rapidly changing between a low and a high frequency using a transmitter modified for ionospheric scatter operation. We envision changing frequency on a push button basis, but this will depend on the results of our investigation.

When the decision was made to lengthen the path by moving the terminal from Loring to Wachusett Reservoir, an opportunity presented itself to incorporate some improvements as well as to test several new ideas. As an example, the length of the transmission lines and the amount of power transmitted through these lines led to the idea that some of the difficulty caused by off path reception may have been due to radiation from the line. Incorporated in the new installation is a coaxial transmission line and coaxial feeders, which replace the open wire transmission line and feeders. Beam splitting is provided in an attempt to reduce multipath reception. The beam is split remotely by rephasing some of the driven elements. The power in the main lobe is split into two lobes approximately 8 degrees on each side of the center of the normal beam. The idea behind this technique is that when delayed signals due to multipath are received when operating with the normal beam, a change in propagation path may alleviate

(*Continued on page* 45)

When the first
flying boat
was launched...

Sperry was already providing SERVICE!

Back in 1912 when Elmer Sperry designed and installed the first automatic flight control system for the first Curtiss Flying Boats, company engineers were

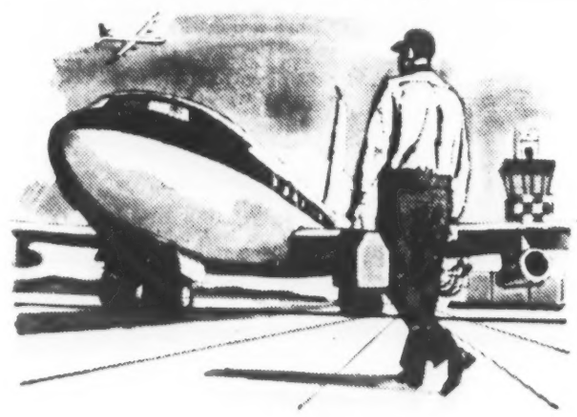
already trained to instruct pilots in its proper use, provide expert maintenance, and make repairs as required.

From this philosophy of making certain that customers get the full benefits of skilled engineering throughout the life of every Sperry product or system grew a unique and complete field engineering service.

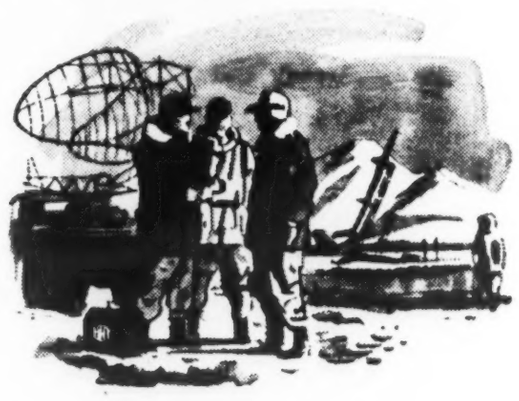
Sea Captains soon found that in any part of the world Sperry engineers were always close at hand—ready to adjust or service the Gyro-Compass and Gyro-pilot*, and later on, Sperry Loran, Radar and Gyrofin* ship stabilizers.

With development of world-wide aviation, airlines and military agencies found Sperry facilities available abroad providing prompt service on flight control systems and all forms of Sperry instrumentation.

In World War II and the years that followed, Sperry still further extended field engineering to every branch of the



military, from the tropics to the arctic regions – servicing intricate bombing, gunfire control, and missile systems, keeping radar and other electronic gear in prime condition.



Today there are more than 900 Field Service Engineering personnel assigned to Sperry products in three major areas –service, training and product repair. Supporting each of these services are specialized product engineering staffs. Through this concentrated team effort, customers are assured that they receive the full value engineered into every Sperry product or system. *T.M.

SPERRY GYROSCOPE COMPANY
Great Neck, New York
DIVISION OF SPERRY RAND CORPORATION

the effect ot multipath signals. Splitting the beam gives us this change in path. Another idea which has been incorporated should probably be considered a procedural rather than a technical change. At the Wachusett Terminal two transmitters are driving the antenna simultaneously. The two transmitters are normally considered one operating and one spare. But in this case both are operated at half power and both are on the line. In the event of failure of one transmitter the other continues to supply energy at the half power rate until the maintenance man boosts the power. Thus the circuit doesn't become inoperative due to equipment failure. This scheme permits a hot running spare and prolongs the life of the equipment because the units are loafing along most of the time.

Improvements for Performance

The Air Force has had an antenna improvement program underway at the United Kingdom terminal for some time. Several ideas have been advanced to improve the characteristics of the corner reflector antenna as far as side and back lobe radiation is concerned. As I have mentioned, shielding transmission lines and antenna feeders by replacing them with coaxial cable was one of the first improvements that was accomplished. Another idea had to do with providing greater shielding of the driven elements of the antenna; the reflector screen consists of horizontal wires which, it was believed, did not discriminate sufficiently against a back scattered signal which was randomly polarized and had a significant vertical component. In order to give protection against the vertical component as well as the horizontal, vertical wires were added to the screen. To afford greater shielding of the elements the ends of the corner reflector were closed in, and the elements themselves were moved closer to the corner. Moving the elements gave a one decibel loss but compensation in the form of greater freedom from back scatter was expected. What we really need is an antenna with no side or back lobes, but until such a system is designed which will be practical for our use we will have to continue trying different schemes which may improve the characteristics of existing antennas.

Due to the rapidity with which the ionospheric scatter circuits were implemented none of our transmitters is standard. By this we mean that the equipment has not been standardized for use by the Services. The equipments we are using are high frequency transmitters which have been modified for ionospheric scatter operation. At the Wachusett terminal we have two transmitters which were designed and built for ionospheric scatter. The original circuits of the North Atlantic System used BC-779 and FSK-I receivers. At the present time the receivers and transmitter exciters are known as the FSK-II system. The teletype multiplex equipment has been the four channel AN/FGC-5. A sixteen channel time division multiplex for teletype has been incorporated in the system from Wachusett to Thule on a service test basis. Operational traffic continues to be passed over the circuit during the tests. This equipment is identified as the AN/TCC-35. We have recently set forth production specifications for the AN/FRC-46, a system which we believe incorporates the latest ideas for ionospheric scatter transmission. These specifications are for production models and are designed as tentative standard at this time.

At the present time we have a capability of one voice and sixteen teletype channels to Thule. The circuit to the United Kingdom has the capability of one voice and four teletype channels. Our goal is three voice and sixteen teletype over our ionospheric scatter systems.

The performance of our tropospheric scatter circuits has been quite good—better than 99 per cent reliability. But due to the critical requirement for communications in support of the Air Defense Mission, we are striving to improve this mode of communication in an attempt to come as close to 100 per cent as possible. The equipment used thus far for tropospheric scatter has been of commercial type. Specifications have been written for two standardized packages, one package could contain either a one KW or ten KW transmitter, and the other a fifty KW transmitter. The antennas used for this mode are paraboloids of one type or another—either the dish, which may be twenty eight or sixty feet in diameter, or the billboard, which may be sixty or one hundred-twenty feet in effective diameter.

Tropospheric scatter has a channel capacity which usually depends upon the operational requirement. That is, by increasing the size of the antennas or the transmitter power, or both, the channel capacity can be significantly increased. In general the Air Force circuits are designed for thirty-six or seventy-two voice channels.

I have mentioned that rhombic antennas were originally used on our ionospheric scatter circuits. Now it appears that the large corner reflector antennas probably give the best results for ionospheric scatter. But in the process of searching for the best antenna several types were tried. Probably the most remarkable of these is the large stacked yagi which was constructed at Goose Bay to receive the Narsarrsuak signal. This antenna is actually an array of four yagis with some sixty-two elements.

All receiving antennas are placed in space diversity to enhance the received signal. This does not mean that the two receiving antennas have necessarily the same configuration. At Thule for instance we are using two rhombics and a corner reflector of smaller dimensions than I've previously described to give triple space diversity.

In the design of tropospheric scatter systems, in addition to space diversity which has become standard in all installations, provision for polarization diversity is being considered more and more routine. Frequency diversity, although desirable in many cases, is usually ruled out due to the difficulty in obtaining additional frequencies.

We feel that scatter in both modes has a potential which has not been fully exploited at this time. The Air Force has contracts to study various phases of scatter which indicate that scatter can be used to a greater degree than we are using it today. We would like to use meteor trails as the scattering medium. The meteor scatter mode of propagation appears to offer a great degree of immunity to interception. It is probable that meteroic scattered signals would be difficult to jam. There exists a possibility that scatter communication can be used to extend the ground-air communication range. This possibility must be further investigated. The present concept of operation in the Air Force dictates that we must provide circuits which give an increase in capacity and versatility in the type of information which can be transmitted. In addition to our voice and teletype capability we would like to transmit computer data, weather facsimile and television over scatter circuits. We would also like our scatter circuits to be so reliable that error correction would not be required.

Some of the studies now underway in the meteoric scatter mode indicate that we may be able to use meteoric scatter and ionospheric scatter simultaneously on the same circuit in order to increase our traffic handling capability. Meteoric scatter mode offers a capability which is comparable to ionospheric scatter and requires less power in most applications. These factors may permit mobile meteoric scatter installations capable of thousand mile ranges, without the large antennas and critical siting requirements now necessary for ionospheric scatter installations. Tropospheric scatter lends itself quite readily to mobile installation. Our Tactical Air Force is quite interested in the application of mobile tropospheric scatter to meet their communications requirements.

Men, Money and Mode

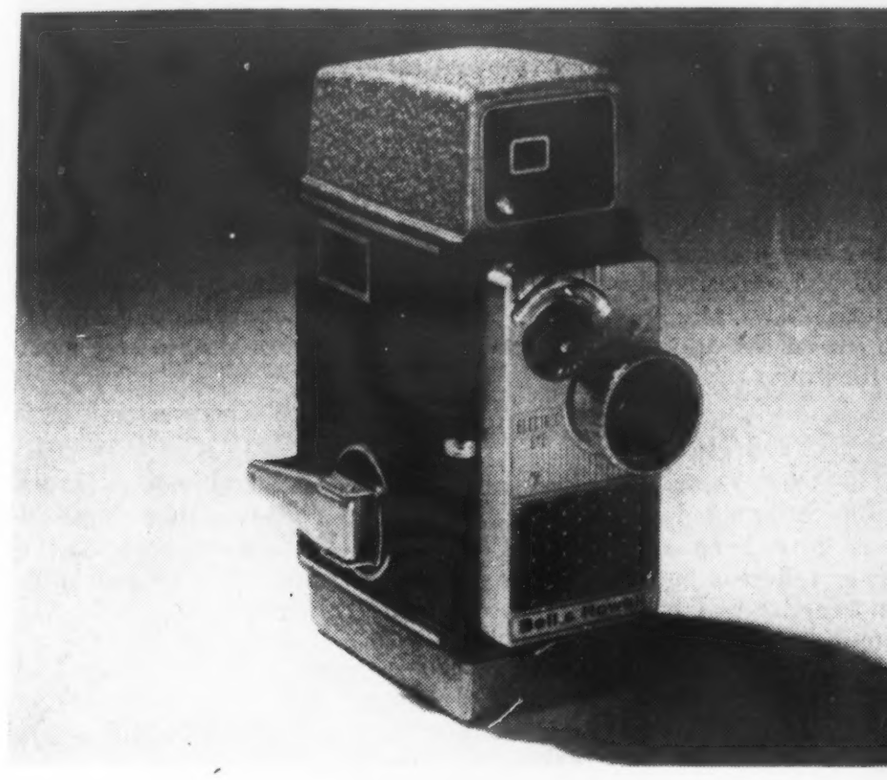
With the advent of new techniques of communication and the attendant change in equipment, we are faced with a problem which though it is always with us, takes on an even more serious aspect. The problem is that of training maintenance men. To increase our training capability we have a contractor technician at each scatter site who is responsible for training the airmen at the site as well as to perform maintenance on the equipment to keep it operating. To further enhance our training capability in the field of scatter, we are establishing formal courses of instruction in both the tropospheric and the ionospheric modes.

The added training problem is just one factor which we must consider when we figure the cost of operation of our scatter circuits. The North Atlantic system consisting of four links has cost about eight and one-half million dollars. Included in this cost is the initial test circuit from Goose Bay to Sondestrom and many modifications made subsequent to the initial installation. This cost figure represents the cost of engineering, installation, modification of transmitters, and cost of some equipment. The terminal at Wachusett, which we consider our most modern terminal, has cost about 1.2 million dollars, including buildings, power units, equipment and installation. If our reliability can be increased by the use of the scatter mode of propagation, we must use that mode of propagation even though the cost may be somewhat higher than other methods. If scatter techniques provide the means whereby radar early warning is reliably communicated from the DEW Line; or the means whereby strategic bombers can be rerouted to alternate targets and thus increase the effectiveness of our retaliatory effort, then I think that we would consider the money spent on improving our communication by the use of scatter had been well worth it. But in the Air Force concept of constant radar surveillance and a retaliatory bomber force in being, we cannot wait for these eventualities to occur. Our situation is such that we must investigate and exploit every new technique as it is discovered if by doing so we increase our capability in the communications area. But actually, in the Arctic the cost of scatter communication is lower than other methods capable of providing reliable communication; this is especially true of tropospheric scatter, as I've mentioned earlier.

Editor's Note: This concludes the panel presentation on Scatter Propagation by representatives of the Department of Defense.

photoprogress

by FRANK SMITH
PHOTO EDITOR
SIGNAL



Bell & Howell
8mm Motion
Picture Camera

New Sun-Powered Automatic 8mm Motion Picture Camera by Bell & Howell

With a great many devices being sun-powered these days, such as telephones, radio sets, etc., it would be only natural that the same idea would sooner or later be applied to photographic equipment in some form or other. That this has been done is contained in a recent announcement by the Bell and Howell Co., 7100 McCormick Road, Chicago 45, Ill., who have harnessed solar energy to set the lens of a new automatic 8mm motion picture camera designated as the "Electric Eye." The new camera is said to be the first in the world in which solar energy alone supplies the power to generate the electric current which adjusts the lens. No batteries, motors or springs are used for the exposure setting. The current is transmitted directly from the photoelectric cell to a mechanism controlling the lens iris.

It is also said to be the world's first completely automatic motion picture camera in 8mm size. All the operator has to do is wind the camera, sight, and shoot. The electric eye, which adjusts to changing light faster than the human eye, sets the lens for proper exposure before the starting button is touched. It can operate the lens through its full range of stops from f/1.9 to f/16 in less than one second. This means that without knowing what an f/stop is, the novice can be sure of properly exposed film every time, a result not consistently achieved even by experts.

To make feasible the design approach of the electric eye, Bell and Howell engineers developed a new type of lens iris so sensitive that it moves at the touch of a human hair. Yet it is sturdy and shockproof and has withstood the most vigorous environmental and field tests.

Through the use of thermistors, the electric eye mechanism adjusts to temperature changes. The camera can be used at any temperature extremes the film itself will withstand.

Light reflected from the subject enters a reticular honeycomb lens which controls the angular coverage to match that of the camera lens. Upon reaching the photocell, the light generates an electric current which is fed to the meter mechanism. The meter computes the correct exposure and opens or closes the lens as required. Linked to the control mechanism is a needle pointer which moves back and forth along a visible scale, indicating the opening at which the lens is set. The scale is marked in f/stops of 1.9, 2.8, 4, 5.6, 8, 11 and 16. The camera can also be operated manually.

Features of the new camera include a 10-foot sprin
run with continuous run lock and single frame exposur
a picture-window viewfinder which shows the subject i
actual size, and Bell and Howell Super Comat 10mm f/1.
lens. It uses economical 8mm roll film. Wide angle an
telephoto attachments are available as accessories.

The camera is immediately available. Price: $169.9

"Sylvatron" Image Producing Panel

The production of images on flat panels, by combinin
the sciences of lighting and electronics, has been an
nounced by Sylvania Electric Products, Inc., 1740 Broad
way, New York 19, N. Y.

The image producing panel, called "Sylvatron," com
bines the principles of electroluminescence and photo-con
ductance to produce images on flat panels. It is believe
that the device will have important possibilities in de
velopment of radar, air traffic control, computers, an
instrumentation.

Development of the panel is an outgrowth of "Paneles
cent" lighting which was introduced by Sylvania si
years ago. The "Panelescent" lamp produces light b
electroluminescence, or the production of light by direc
excitation of certain phosphors in an electric field.

The new image-producing panels utilize not only thi
principle of electroluminescence, but also the principle o
photo-conductance, which is the influence of light on th
flow of electricity through a solid.

The device consists of flat glass electroluminescen
panels with various control layers. These control layer
are thin coatings of photo-conductive and electro-conduc
tive surfaces.

When electrical or optical signals and a power source
are applied to the panel, a visual display, or image, is pro
duced.

Three types of panels, which produce different images,
have been developed. They include: an electroluminescent
panel on which the position of a mobile dot of light can
be manipulated electrically; a display panel which re
produces optically the track of a mobile spot of light. The
image thus created can then be held or "stored" inde
finitely in visible form on the panel; an electrolumin
escent panel which can reproduce optically a motion pic
ture with good resolution and rapid response.

The device to date has been produced in the laboratory
in two-inch and four-inch squares. Larger units are now

(*Continued on page* 48)

TACAN unit shown with covers removed; plane is a composite model.

78-~~page~~ tube road map for jets

An 800-foot carrier may be as hard to find as a needle in a haystack, when the plane seeking it is at 20,000 feet and the time is 0200 hours.

To make the homing plane a homing pigeon, we build the "ARN-21" TACAN equipment illustrated above. Its 78 tubes and associated components add up to a self-contained transmitter and receiver, rugged in its ride-resistance and accurate to pin-point tolerances.

The manufacture of equipment as important and complicated as this demands *perfection*, and nothing less. On the military as well as the home front, Stromberg-Carlson has long displayed the ability to take such problems in stride.

STROMBERG-CARLSON

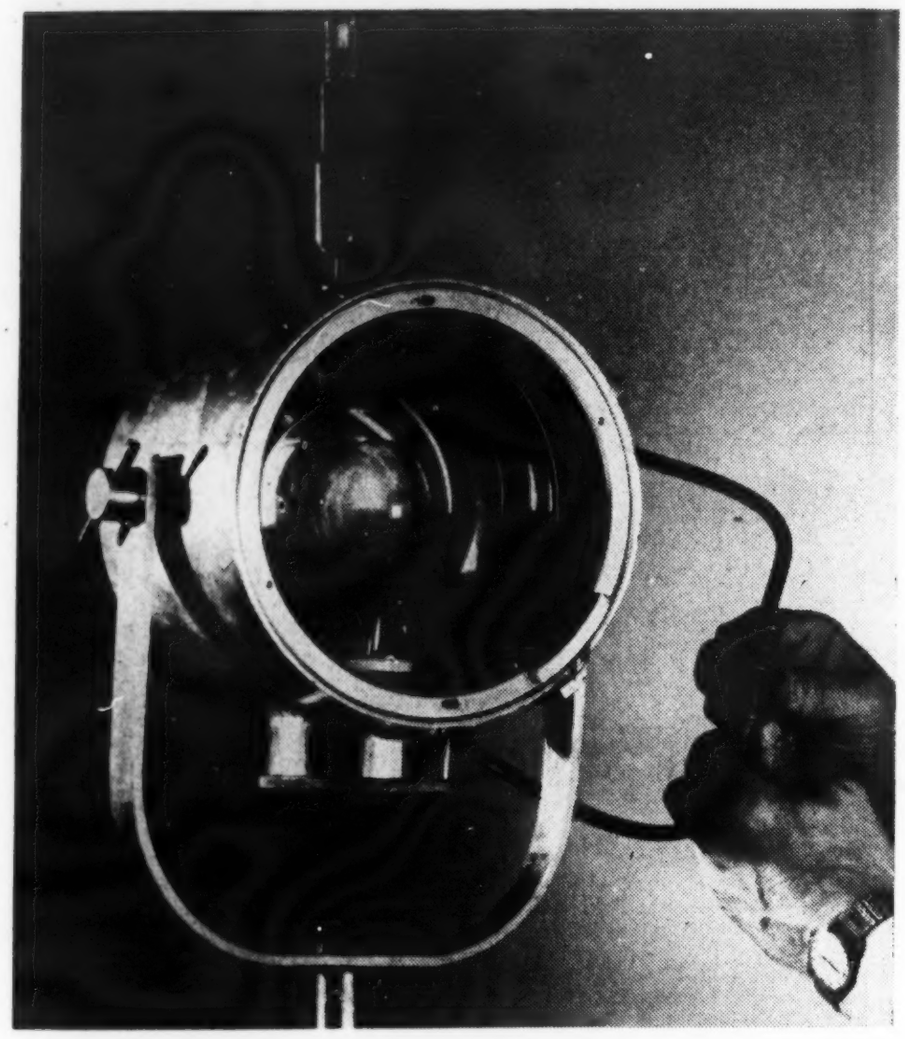
A DIVISION OF GENERAL DYNAMICS CORPORATION

General Offices and Factories at Rochester, N. Y.—West Coast plants at San Diego and Los Angeles, Calif.

being developed for certain military applications. The only limitation in size is the size of the production machinery itself.

While the device is considered to be still in the laboratory stage, it is considered to be advanced enough for application development by electronics and defense laboratories and for such application development under military contracts.

One item alone which is sure to excite considerable interest in the motion picture field is a statement by the company that two of the three types of panels can be combined to form a fourth type which could electronically (as opposed to optically) reproduce motion pictures!



Bureau of Mines Safe Photoflash Unit

A new era in coal mine photography has been opened by the Bureau of Mines, Department of the Interior, with the announcement that it has developed the first safe photoflash unit for underground use. The unit (shown above) can be used anywhere in a coal mine without igniting coal dust or the explosive gas, methane.

The unit is essentially a 7-7/16 inch diameter reflector and socket which will accomodate flash bulbs up to and including the size"50," in an explosion-proof aluminum housing. Its over-all dimensions are 8⅝ inches in diameter and 5⅝ inches deep and weighs 12 pounds. It is so designed that the bulb can be safely inserted in the presence of explosive atmospheres.

The flash bulb can be triggered by the contacts in a camera or by a photo-electric cell mounted on top of the unit, in which case it serves as a slave unit.

The energy in the cord between the photo-electric cell and the bulb circuit inside the lamp housing is below the value at which it is possible to get an incentive spark.

The energy for setting off the flash bulb is supplied by a condenser discharge. The components for this circuit are all enclosed within the explosion-proof housing behind the reflector.

The unit features a foolproof arrangement which permits bulbs to be removed quickly and safely. Flash bulbs are changed merely by removing the socket base, since no wires are attached. An electrical interlock makes the internal circuit dead when the base is unscrewed less than one turn.

Development of the photoflash unit followed the perfection last October by the Bureau of an approved floodlight for use in coal mining motion picture photography. Commercial firms are free to manufacture the photoflash units without license. Persons interested in further details of both units should write the Branch of Electrical-Mechanical Testing, Bureau of Mines, 4800 Forbes Street, Pittsburgh 13, Pa.

High-Speed Photography

As stated before in this column, the reviewing of books is generally left to our book department, but occasionally an unusual book covering some phase of photography is received which practically dictates that it be reviewed in this column. Such a book is the one entitled *Third International Congress on High-Speed Photography,* just received from the publishers, Academic Press, 111 Fifth Ave., New York 3, N. Y. This beautiful volume is edited by R. B. Collins and consists of 417 pages of the proceedings and discussions of the above congress which were held in London in 1956.

All papers submitted for presentation at the congress were considered by an editorial panel, who, as far as possible, accepted only reports of new work and automatically rejected any material which had been published elsewhere. This strict editorial policy has meant that the papers published in these proceedings are of a high standard, describing techniques and applications not otherwise available in published literature.

As an indication of the extensive coverage of this volume, one has but to scan through the various sections into which it is divided and which total 16 in all. Titles of some of these sections are as follows: "Flash Light Sources" (I and II); "Image-Splitting and Image-Sampling Techniques;" "Inertialess Shutters;" "Applications to Ballistics and Explosives;" "Photographic Materials;" "X-Rays;" "Film Evaluation;" "Schlieren and Interferometric Techniques;" "Rotating Mirror Cameras;" "Medium Repetition Rate Cameras;" "Application to Aerodynamics," and "Application to Hydrodynamics." Some 60 papers are included under these headings covering practically everything that is new in the way of techniques, materials and processes in the field of high-speed photography.

The book is well written and contains 243 excellent illustrations which form a fitting accompaniment to the text. Priced at a modest $13.00, the volume is a "must" for anyone interested in high-speed photography.

While we are on the subject of photographic literature, your attention is called to a volume of 35 pages entitled *Bibliography on High-Speed Photography* compiled by Elsie L. Garvin, Librarian, Research Library, Eastman Kodak Co., Rochester, N. Y.

According to an announcement in the bibliography, the material up through 1953 was originally compiled by Elsie L. Garvin and classified by John H. Waddell, Chairman of the High-Speed Photography Committee of the Society of Motion Picture and Television Engineers. It was published in two installments in the Journal of Motion Picture and Television Engineers, 56: 93-111, January 1951, and 61: 749-757, December 1953. References through December 1955 have been added and classified, as in earlier publications, under the following headings:

(1) General; (2) Cameras; (3) Lighting; (4) Oscillograph Photography; (5) Schlieren Photography; (6) Technical and Techniques and (7) X-Ray.

(*Continued on page* 50)

FRONT-LINE STORY

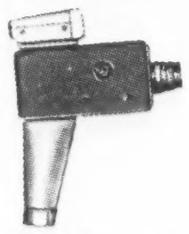
Seen and heard at Command Post by means of world's smallest TV and Radio Communication facilities

The soldier you see carries the new RCA one-pound, postcard-size ultra-miniaturized TV camera connected to a miniature TV transmitter on his back. Concealed in his helmet is a complete radio receiving-transmitting set weighing only a few ounces. He is one of several similarly equipped men covering the battle area from a number of positions in the air and on the ground.

At the command post the troop commander *SEES* enemy movements on television screens and *HEARS* first-hand reports. Their resulting immediate control of the situation is based upon accurate, instantaneous first-hand knowledge.

In achieving this miracle of miniaturization, through the use of transistors, printed circuits and the latest electronic technology, RCA has again made a major contribution to the industry and all our armed services.

Transistorized radio receiver transmitter completely concealed in helmet has up to 5-mile range.



"Telemite," smallest TV camera, features newly developed RCA ½-inch Vidicon tube, size 1⅞" x 2⅜" x 4¾", weighs about one pound.

DEFENSE ELECTRONIC PRODUCTS

RADIO CORPORATION of AMERICA

CAMDEN, N. J.

Tmk(s) ®

This little volume provides a convenient reference to a vast amount of knowledge accumulated over the years about high-speed photography and its application in many, many branches of science and engineering. It forms a fitting companion to the one reviewed above and is recommended for anyone interested in the subject.

Fast Photography—15,000,000 Pictures Per Second!

Although details of the 15,000,000 frame per second camera of the Los Alamos Scientific Laboratory of Los Alamos, New Mexico, are well known to most specialists in the field of high-speed photography, it is thought that these details would also be of interest to non-specialists who may not be familiar with this camera.

This camera, which was developed by the staff of the laboratory has been considerably improved since the first model 6 was announced by Mr. Berlyn Brixner of the laboratory staff in October 1952 at a meeting of the Society of Motion Picture and Television Engineers in Washington, D. C.

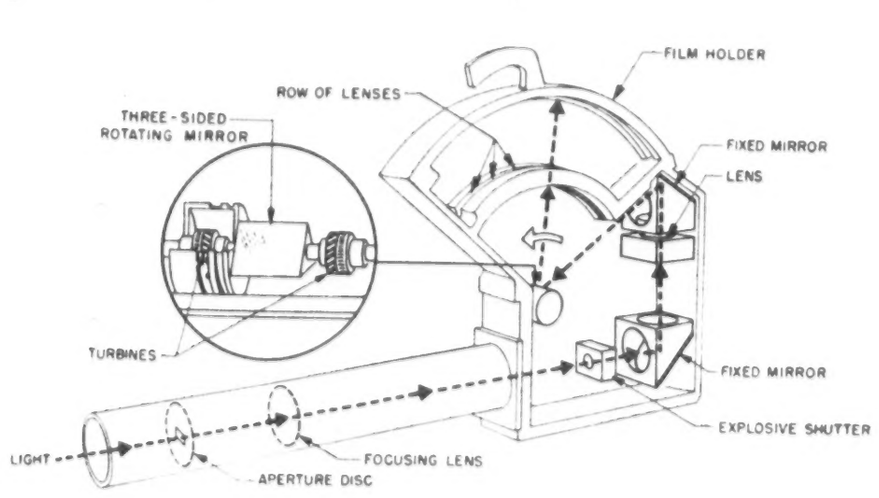
The improved version, known as model 8 and believed to be the fastest of its kind ever constructed, takes motion pictures of explosive phenomena and other high-speed actions at the remarkable rate of 15,000,000 frames per second, and will take up to 96 consecutive pictures of a single event.

In order to increase the speed from 3,500,000 to 15,000,000 frames per second, the three-sided mirror in the new model 8 camera has now been made to revolve 23,000 times per second (1,380,000 times a minute).

The mirror is made of special steel having a tensile strength of over 300,000 pounds per square inch; this great strength is needed because of the tremendous forces tending to explode the rapidly revolving mirror. The mirror spins in a helium atmosphere on oil pressure lubricated bearings and is powered by a small helium-driven turbine.

The shutter system is another novel feature of the high-speed, rotating-mirror camera. Since the entire strip of film is exposed in about 1/150,000th of a second, no mechanical shutter could be devised to close fast enough to prevent the reflected beam from sweeping across the film a second time and double-exposing the film. Brixner and his staff arranged an electric detonator to shatter a glass block in the light path, the shattered block being opaque enough to bar the light until a mechanical shutter can close.

The improved camera's speed of 15,000,000 frames per second is illustrated by the fact that a beam of light, traveling across the field of view at 186,300 miles per second, moves only a little over 65 feet in the interval between one picture and the next.



A schematic diagram of the Los Alamos Model 8 15,000,000 frame-per-second camera, showing the path of light rays.

Although the new model 8 camera is housed in a rugged cast aluminum frame to withstand severe shocks, it is light enough to be easily carried. Despite its remarkable speed, it is simple enough to be operated by one man.

The light from the explosions photographed with this camera is so brilliant that the optical system may be as slow as f/25 to f/100. The film used is standard high-speed 35mm film, and is not "souped up."

In the case of a non-luminous event being photographed, the necessary light is furnished by some other source. An explosion shock front traveling through argon gas is sometimes used as such a secondary source of light; the argon atoms give off an intense flash when excited by the shock front.

One more item of interest: Operating at its top speed, the new camera makes pictures at 625,000 times the rate used for standard motion picture theater film.

Thermography—Photography in the Dark

An entirely new concept in infra-red photography called "Thermography" has been announced by the Barnes Engineering Company, 30 Commerce Road, Stamford, Conn.

Briefly, "thermography," or the recording of infra-red radiation, is done by a device known as the Opti-Therm imaging attachment, which is essentially a combination scanner and photographic recorder which scans the detector field of a radiometer over the object, and simultaneously produces a photographic thermal image or "thermograph" of the scene. Variations in density on the photograph correspond to the radiance level or temperature of the object being scanned.

A large plane scanning mirror in front of the radiometer scans a 10-degree horizontal by 10-degree vertical field. The radiometer is stationary and "looks" into this plane scanning mirror; thus the radiation entering it is on its axis at all times. A cam drive causes the mirror to oscillate horizontally to scan a line 10 degrees long. At each extremity of this scan, the mirror is indexed vertically by another cam through an angle equal to the height of the detector field of view. This continues until 10 vertical degrees are covered.

A small mirror mounted on the back of the large scanning mirror deflects a spot of light from an intensity modulated glow tube onto Polaroid Land film. Since this mirror is rigidly fixed to the large scanning mirror, the light spot traces out a raster on the film which is exactly the same as the radiometer scan pattern. The electrical output signal from the radiometer is used to modulate the intensity of the glow tube. Thus while the object is being scanned, a "thermal" image of the scene is being simultaneously produced on the film.

The OptiTherm scanning attachment is useful for any application where a two-dimensional radiance or temperature distribution is required, i.e., a thermal contour map of an object or scene. For example, it could be used to obtain the temperature distribution over the surface of an airfoil in a wind tunnel or over chemical reaction equipment, such as a cracking tower. Another class of application is to the study of background radiation and radiation from military targets such as tanks and aircraft.

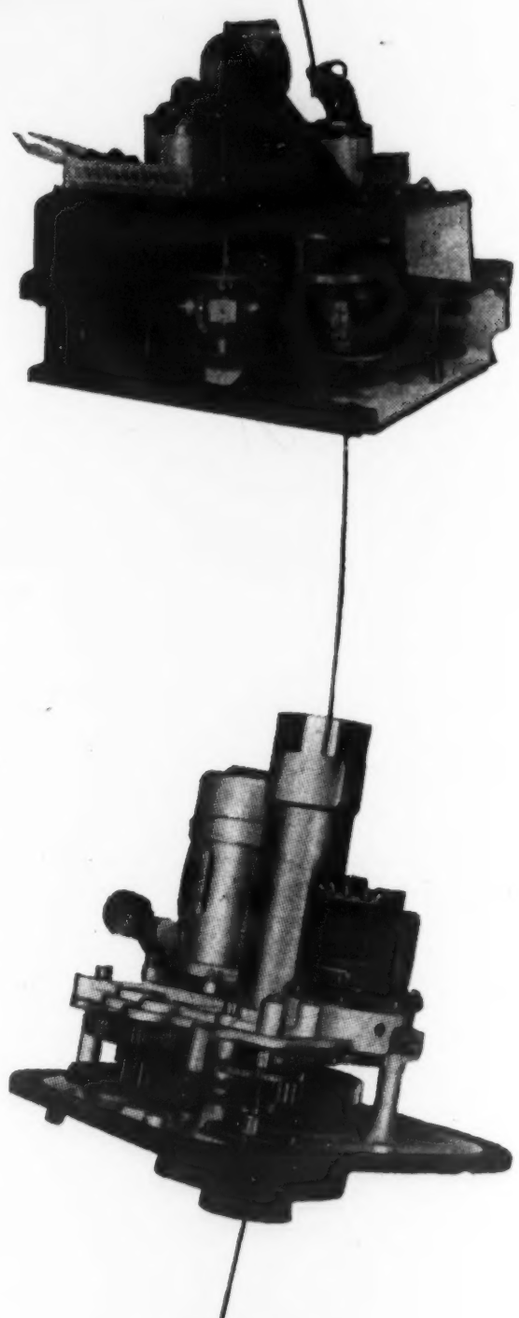
The imaging attachment may be mounted quickly and easily in front of the radiometer, and all electrical connections required are readily made to existing receptacles on the radiometer amplifiers. A 10-degree by 10-degree field of view is formed on Polaroid Land film, or standard cut film, in as little as 30 seconds. Temperature differences of 0.2 degree C are easily detectable at maximum sensitivity.

This Is Where Atlas Can Help You In Your Missile Program

Where do you stand on your missile or aircraft program? Do you have a new contract for radar, computers or guidance control mechanisms? Then let Atlas help you from pilot stage to production efficiency.

Atlas design, production and methods engineers, toolmakers and skilled mechanics are ready to work on your project on a job basis . . . as many men, machines and hours of work it requires and no more. Every modern, cost cutting tool, technique and quality control method is utilized. Atlas mechanical and electronic technicians thoroughly test your product.

Let Atlas help you in your program. We've been "precision-eering" on a contract basis for more than a quarter of a century. May we work for you? Write to us with your production and design problems . . . get your copy of the booklet "Precision-eering Electro-Mechanical Equipment." Atlas Precision Products Co., Philadelphia 24, Pa. (Division of Prudential Industries).



"From Drawing Board . . . to Production Line"

ATLAS
Precision Products

AFCEA

1624 Eye Street, NW
Washington 6, D. C.
Phone: EXecutive 3-3033

OFFICERS

President
Frederick R. Furth*
1st Vice-President
Maj. Gen. Alvin L. Pachynski, USAF*
2nd Vice-President
Maj. Gen. James D. O'Connell, USA*
3rd Vice-President
RAdm. Henry C. Bruton, USN*
4th Vice-President
Joseph E. Heinrich
5th Vice-President
John R. Howland
General Counsel
Ralph L. Walker
Secretary
Julia B. Godfrey
Treasurer
Frank Martins

DIRECTORS

1958
George W. Bailey*
W. R. G. Baker
Theodore L. Bartlett
Maj. Gen. Gordon A. Blake, USAF
Donald F. McClure
Fred E. Moran
Leslie F. Muter
Fred J. Turner

1959
Frederick R. Furth*
George W. Goddard
William J. Halligan
William Kahler
Frederick R. Lack*
Walter P. Marshall
Raymond C. Maude
Ellery W. Stone

1960
Francis L. Ankenbrandt
Percy G. Black*
Theodore S. Gary
Charles F. Horne
David R. Hull
Frederick R. Kappel
J. Harry LaBrum
David Sarnoff

1961
Harry E. Austin
Roland C. Davies
E. K. Foster
Francis H. Lanahan
Joseph R. Redman*
Robert C. Sprague
W. W. Watts*
Frank W. Wozencraft

The President and Vice-Presidents are ex-officio members of the Board of Directors.

Past Presidents
David Sarnoff
Frederick R. Lack*
Theodore S. Gary
William J. Halligan
W. Walter Watts*
Joseph R. Redman*
George W. Bailey*
Percy G. Black*
**Executive Committee Member.*

Association affairs

Honor Graduate Awards

The Armed Forces Communications and Electronics Association Award for outstanding scholastic achievement was recently presented to honor graduates at the Signal School, Fort Monmouth, N. J.

Eleven of the honored officers were enrolled in the Signal Officers Basic Course which is designed to give a working knowledge of the duties and responsibilities which the newly commissioned officers may expect during their early service with the Signal Corps.

Highest percentiles in the basic course were held by the following:

Section 740—Second Lieutenant Richard N. Bazinet of Lyons Hill Road, Athol, Mass., is a graduate of Worcester Polytechnic Institute, and majored in E.E.

Section 741—Second Lieutenant Glenn W. Long of 805 Third Avenue, Selma, Ala., who studied industrial management, is a graduate of Alabama Polytechnic Institute.

Section 742—Second Lieutenant William T. McKay of Clough Hill Road, RFD #8, Concord, New Hampshire, is an E.E. graduate from Northeastern University.

Section 743—Top honors went to Second Lieutenant Robert A. Weaver, Jr., of 86 Parker Road, Osterville, Mass.

Section 744—Second Lieutenant Benny B. Barnes, of 105 Brentwood Dr., Rt. 6, Gadsden, Ala., is a graduate of Alabama Polytechnic Institute and majored in E.E.

Section 745 — Second Lieutenant Joe R. Tucker, of Rt. 1, Weatherford, Texas, studied M.E. at the Texas A & M College.

Section 746 — Second Lieutenant Ernest E. Tabor, of Box 395, Delbarton, West Va., took top honors.

Section 747 — Second Lieutenant Chester H. Walters, of 2637 Jackson Street, Ashland, Ky., was a major in M.E. at the University of Kentucky.

Section 748 — Second Lieutenant Robert B. Phillips, of 1685 Highland Avenue, Vero Beach, Fla., majored in E.E. at Tennessee Polytechnic Institute.

Section 749 — Second Lieutenant Jerry C. Russell, of 1303 East Second Street, Indianola, Iowa, studied E.E. at Iowa State College.

Section 750 — Second Lieutenant James C. Lake, 4333 Fairview Avenue, Downers Grove, Ill., is a graduate of Purdue University where he majored in E.E.

In the Radar Maintenance and Repair Officer Course, Section 4018, Second Lieutenant Lawrence C. Seybold, of 215 State St., New Orleans, La., who is a graduate of Tulane University, scored highest academically. This course is designed to train officers to supervise the maintenance and repair of radar and counter measures equipment.

First Lieutenant Bill C. Powell, of 2321 13th St., Lubbock, Tex., a graduate of Texas Technological College, took high honors academically in the Electronic Warfare Officer Course. The purpose of the course is to train officers to direct and supervise electronic counter measures activities.

Introducing AFCEA's New Group Member

The AFCEA welcomed Union Carbide Corp., of New York City, N. Y., as a group member in August. Union Carbide is a long established firm in the New York area and deals primarily in chemicals, plastics, metals, alloys and batteries.

The members of the firm who will be company representatives in AFCEA are: H. H. Babcock, Assistant Secretary-Treasurer; F. S. Badger, Vice President, Haynes Stellite Co., Kocomo, Indiana; M. H. Barnes, Associate Manager of Research, Linde Co., Speedway Laboratories, Indianapolis, Indiana; W. J. Canavan, Assistant Manager, Product and Process Department; L. M. Currie, Vice President, U. C. Nuclear Co., R. L. Glover, Assistant to Vice President, National Carbon Co.; R. M. Joslin, Manager, Fine Chemicals Division, U. C. Chemicals Co.; L. J. Sinnott, General Sales Manager, Silicones Division; H. R. Spendelow, Jr., Manager, Patents and Licenses, Electro-Metal Co.; C. O. Strother, Assistant Manager, Physical Chemical Research Administration.

ROTC AWARDS—1957

The Association takes great pleasure in announcing the names of the winners of the Armed Forces Communications and Electronics Association Gold Medal Honor Awards. These medals are awarded annually to outstanding senior Army ROTC, Navy ROTC, and Air Force ROTC students majoring in Electrical Engineering. Selection is made by the Military Staff and the Dean of Engineering of the respective university or college. Some of the criteria for selection include proficiency in education and leadership, moral character, and participation in recognized campus activities—all to a high degree.

In addition to the Gold Medal, the award includes a certificate, a year's membership in AFCEA, and a subscription to SIGNAL Magazine, the official journal of the Association.

A & M College of Texas
Bobby R. Ammer, *Army*
Warren B. Johnson, *Air Force*

A & T College of North Carolina
Jesse J. Bass, *Air Force*

Alabama Polytechnic Institute
Robert C. Haley, *Army*
Harry O. Lindstrom, Jr., *Navy*

Brigham Young University
Horce D. Crandall, *Air Force*

California Institute of Technology
James N. Giles, *Air Force*

Carnegie Institute of Technology
Richard G. Abraham, *Army*
Alvin H. Boerio, *Army* (jr.)
Ivan E. Sutherland, *Army* (soph.)

Case Institute of Technology
Roy A. Wells, Jr., *Air Force*

Catholic University of America
E. Joseph Thompson, *Air Force*

The Citadel
William I. Brownfield, *Army*
Robert C. Fleming, Jr., *Air Force*

The City College of New York
Eli Glazer, *Army*

Clarkson College of Technology
Robert A. Wood, *Army*

Clemson Agricultural College
Homer B. Goff, Jr., *Army*
John H. Turner, Jr., *Air Force*

Colorado State University
Jack D. Gaskill, *Air Force*

Columbia University
Philip T. Mahoney, *Navy*

Cornell University
Army winner not reported
Raymond W. Sears, *Navy*

Dartmouth College
James J. Ventura, *Army*
Richard D. Bugbee, *Navy*

Drexel Institute of Technology
Werner T. Ullrich, *Army*

Duke University
John D. Peyton, *Air Force*
Navy winner not reported

George Washington University
Charles M. Hunter, IV, *Air Force*

Georgia Institute of Technology
Frank B. Cole, *Army*
Harry A. Ecker, *Air Force*
Donald C. Brown, *Navy*

Illinois Institute of Technology
David S. Hall, *Navy*

Iowa State College of A&MA
William J. Ackerman, *Army*
Earl F. Augspurger, Jr., *Air Force*

Johns Hopkins University
William A. Teso, *Army*

Kansas State College
Richard W. Wilson, *Army*
Jerome J. Ewald, *Air Force*

Lafayette College
Army winner not reported

Lehigh University
Richard H. Simpson, *Army*

Louisiana Polytechnic Institute
Air Force winner not reported

Louisiana State University
Irvin T. Strenge, Jr., *Army*
Air Force winner not reported

Manhattan College
Donald F. Metz, *Air Force*

Marquette University
Terrence R. Scott, *Army*
Richard A. Shantz, *Navy*

Massachusetts Institute of Technology
Richard D. Smallwood, *Air Force*

Michigan College of Mining and Technology
Irwin Feldman, *Air Force*

Michigan State University
Gordon R. Morin, *Air Force*

Mississippi State College
Donald E. Meiners, *Army*
Thomas J. Williams, *Air Force*

Montana State College
Army winner not reported
Dennis L. DuVall, *Air Force*

New Mexico College of A&MA
Thurlow Caffey, *Army*
Donald C. Wunsch, *Air Force*

Newark College of Engineering
Frederick M. Stumpf, *Air Force*

New York University
John P. Gsell, *Army*

North Carolina State College of A&E
Louis R. Ledbetter, *Army*
Ashley G. Leggett, Jr., *Air Force*

North Dakota Agricultural College
Air Force winner not reported

Northeastern University
John S. Tuck, *Army*
Neal W. Atkinson, *Army* (jr.)
John E. Radcliffe, Jr., *Army* (soph.)

Northwestern University
Air Force winner not reported

Norwich University
Richard E. Campbell, *Army*

Ohio University
Theodore C. Fisher, *Army*
Jerry F. Thompson, *Air Force*

Oklahoma State University
Keith O. Eaton, *Army*
Keith C. Moumblow, *Air Force*

Oregon State College
William F. Ettlich, *Army*

Pennsylvania Military College
Edward J. Glanfield, *Army*

Pennsylvania State University
Army winner not reported
Thomas D. Quinn, *Air Force*

Polytechnic Institute of Brooklyn
John J. Schultz, *Army*

Pratt Institute
Ronald M. Danno, *Army*

Princeton University
Spencer O. Chagnon, *Navy*

Purdue University
Richard C. Havens, *Army*
William M. Newport, *Air Force*
James W. Cave, *Navy*

Rensselaer Polytechnic Institute
Clement A. Skalski, *Army*
Arthur M. Bennett, *Air Force*
William R. Sutherland, *Navy*

Rose Polytechnic Institute
Robert L. Overpeck, *Army*

Rutgers University
Orville LaMaire, *Army*
Richard J. Gowen, *Air Force*

Seattle University
Thomas I. Eisiminger, *Army*

South Carolina State College
Army winner not reported

South Dakota School of Mines & Technology
Gerald M. Munson, *Army*

South Dakota State College of A&MA
Air Force winner not reported

Southern Methodist University
John E. Davis, *Air Force*

Southwestern Louisiana Institute
Richard D. Daigle, *Air Force*

Stanford University
Stanley C. Fralick, *Air Force*
Alan J. Keller, *Navy*

State College of Washington
Glen G. Langdon, Jr., *Army*

Syracuse University
Arthur J. Heidrich, *Air Force*

Tennessee Polytechnic Institute
Charles B. Jett, *Army*

Texas College of Arts and Industries
Army winner not reported

Texas Technological College
Lewis F. Sitterly, *Air Force*

Tufts College
Richard A. Northrup, *Air Force*
Charles F. Price, *Navy*

Tulane University of Louisiana
Leon M. White, *Air Force*
Fred A. Wulff, III, *Navy*

Tuskegee Institute
John B. Ginwright, *Air Force*

Union College
Donald E. Mack, *Air Force*

University of Akron
Allan R. Thomas, *Air Force*

University of Alabama
William R. Bowen, *Army*

University of Arizona
Air Force winner not reported

University of Arkansas
Heyden Z. Lewis, *Army*
James N. Holt, *Air Force*
University of Buffalo
Wayne L. Fischer, *Air Force*
University of California (Berkeley)
John P. Loughboro, *Army*
Allen C. Slutman, *Navy*
University of California (L. A.)
Air Force winner not reported
William W. Novak, II, *Navy*
University of Cincinnati
Carlisle M. Stickley, *Air Force*
University of Colorado
Robert W. Prior, *Army*
John S. Brown, *Air Force*
George E. Howell, *Navy*
University of Connecticut
Joseph J. Haloburdo, *Army*
Gerald L. Hoefler, *Air Force*
University of Delaware
Leo A. Freeman, *Army*
University of Denver
Richard W. Herter, *Army*
University of Detroit
Army winner not reported
University of Florida
John S. Pohl, *Army*
Walter G. Frederickson, *Air Force*
University of Idaho
Warren J. Seyfert, *Army*
Peter J. McConnell, *Navy*
University of Illinois
William E. Bicknell, *Army*
Earl L. Heacock, *Air Force*
Robert L. Haymaker, *Navy*
University of Kansas
Ned Joslin, *Army*
Paul E. Peters, *Air Force*
University of Kentucky
Henry T. Jaggers, *Army*
Elmo C. Matthews, *Air Force*
University of Louisville
Don R. Winner, *Navy*
University of Maryland
Charles G. Pettit, IV, *Air Force*
University of Massachusetts
Donald G. Fugere, *Army*
William E. Carroll, Jr., *Air Force*
University of Miami
Stuart H. Sanfield, *Air Force*
University of Michigan
David E. Thouin, *Navy*
University of Minnesota
Duane P. Rubertus, *Army*
University of Missouri
Whitson J. Kirk, *Army*
Jimmy R. Buell, *Air Force*
Burton D. Engle, *Navy*
University of Nebraska
John W. Gray, *Army*
William T. Bedwell, *Air Force*
University of Nevada
Charles H. Handley, *Army*
University of New Hampshire
Lawrence R. Maloney, Jr., *Air Force*
University of Notre Dame
James S. Rice, *Army*
Nunzio J. Lizzio, *Air Force*
William F. Reeve, *Navy*
University of Oklahoma
Donald E. Wheatley, *Army*
University of Pennsylvania
Air Force winner not reported
Gary H. Rush, *Navy*
University of Pittsburgh
Frederick E. Symons, *Army*
James D. Anderson, *Air Force*
University of Rhode Island
Richard E. Mosher, *Army*
University of Santa Clara
Richard P. Dolan, *Army*
University of South Carolina
Edward C. Prettyman, *Navy*
University of Tennessee
Air Force winner not reported
University of Texas
Mitchell L. Martin, *Air Force*
James D. Browning, *Navy*
University of Toledo
Donald H. Saunders, *Army*
University of Utah
Gordon T. Longerbeam, *Navy*
University of Vermont
Frederick S. Cramer, *Air Force*
University of Virginia
Frederick J. Aichelmann, Jr., *Army*
Paul R. Little, *Navy*
University of Washington
Carl R. Powers, *Army*
Paul M. Mettret, *Navy*
University of Wisconsin
Robert E. Suelflow, *Army*
University of Wyoming
Charles P. McAlister, *Army*
Thomas E. Osborne, *Air Force*
Vanderbilt University
Kenneth W. Madden, *Army*
Henry Beatty, III, *Navy*
Villanova University
John M. Husted, *Navy*
Virginia Military Institute
Milton I. Hargrave, Jr., *Army*
James C. Kyle, Jr., *Air Force*
Virginia Polytechnic Institute
William L. Coburn, *Army*
William D. Ballard, Jr., *Air Force*
Washington University
Robert G. Dietrich, *Army*
Paul E. Glaab, *Air Force*
West Virginia University
Richard L. Miller, *Army*
Joe N. Nay, *Air Force*
Worcester Polytechnic Institute
Richard G. Bedard, *Army*
Youngstown University
Robert J. Mazur, *Army*

Pictured on the opposite page are some of the ROTC award winners. They are, reading from top to bottom and left to right:

Top Row, Army

Homer B. Goff, Jr.
Clemson Agricultural College
Clement A. Skalski
Rensselaer Polytechnic Institute
John P. Gsell
New York University
John W. Gray
University of Nebraska

Second Row, Army

Richard G. Abraham
Alvin H. Boerio
Ivan E. Sutherland
Carnegie Institute of Technology
William I. Brownfield
The Citadel
Richard L. Miller
West Virginia University

Third Row, Navy

Fred A. Wulff, III
Tulane University of Louisiana
Philip T. Mahoney
Columbia University
Nunzio J. Lizzio
University of Notre Dame
Duane P. Rubertus
University of Minnesota

Fourth Row, Air Force

Arthur M. Bennett
Rensselaer Polytechnic Institute
John D. Peyton
Duke University
John B. Ginwright
Tuskegee Institute

Fifth Row, Air Force

Charles G. Pettit, IV
University of Maryland
Jerome J. Ewald
Kansas State College
Earl F. Augspurger, Jr.
Iowa State College of A & MA
Mitchell L. Martin
University of Texas

FORT GORDON, GEORGIA—Brigadier General Kenneth F. Zitzman (left), representing the Office of the Chief Signal Officer, USA, presents the Armed Forces Communications and Electronics Association Award to newly appointed Second Lieutenant John S. Tuck, of Dedham, Massachusetts. The award was made to Lieutenant Tuck as the outstanding cadet of the 1957 Army Signal Corps ROTC Camp, held at Fort Gordon. The cadet, an honor graduate of Northeastern University's College of Engineering, previously served in the Army as an enlisted man, reaching the rank of sergeant. He was commissioned at the ceremonies, following General Zitzman's address to the cadets on their responsibilities as future officers.

It is significant to note that Lieutenant Tuck was also the winner of the AFCEA Gold Medal Honor Award at Northeastern University as being an outstanding senior ROTC cadet majoring in electrical engineering.

AFCEA Group Members

Communications—Electronics—Photography

Listed below are the firms who are group members of the Armed Forces Communications and Electronics Association. By their membership they indicate their readiness for their share in industry's part in national security. Each firm nominates several of its key employees or officials for individual membership in AFCEA, thus forming a group of the highest trained men in the electronics and photographic fields, available for advice and assistance to the armed services on research, development, manufacturing, procurement, and operation.

Admiral Corp.
Aircraft Radio Corp.
Allied Control Co., Inc.
Allied Radio Corp.
American Cable & Radio Corp.
American Electronic Laboratories, Inc.
American Institute of Electrical Engineers
American Machine & Foundry Co.
American Radio Relay League
American Telephone & Telegraph Co.
American Telephone & Telegraph Co., Long Lines Dept.
Ampex Corp.
Amphenol Electronics Corp.
Anaconda Wire & Cable Co.
A. R. F. Products, Inc.
Arnold Engineering Co.
Atlas Precision Products Co.
Automatic Electric Co.
Automatic Electric Sales Corp.
Automatic Telephone & Electric Co., Ltd.
Barker & Williamson, Inc.
Barry Controls, Inc.
Bell & Gossett Co.
Bell Telephone Company of Pa.
Bell Telephone Laboratories, Inc.
Bendix Radio Division, Bendix Aviation Corp.
Blackburn Electronic Corp.
Bliley Electric Co.
Bomac Laboratories, Inc.
British Thomson-Houston Co., Ltd.
Bruno-New York Industries Corp.
Burroughs Corp.
California Water & Telephone Co.
Cambridge Thermionic Corp.
Capitol Radio Engineering Institute, Inc.
Carolina Telephone & Telegraph Co.
Central Technical Institute
Chesapeake & Potomac Tel. Co.
Cincinnati & Suburban Bell Tel. Co.
Collins Radio Co.
Columbia Broadcasting System, Inc.
Compagnie Francaise Thomson-Houston
Contraves Italiana
Convair, Division of General Dynamics Corp.
Cook Electric Co.
Copperweld Steel Co.
Cornell-Dubilier Electric Corp.
Craig Systems, Inc.
Crosley Division-Avco Mfg. Corp.
Dana, P. A., Inc.
Designers for Industry, Inc.
DeVry Technical Institute
Diamond State Telephone Co.
Dictaphone Corp.
DuKane Corp.
DuMont, Allen B., Laboratories, Inc.
Eastman Kodak Co.
Electronic Associates, Inc.
Electronic Communications, Inc.
Elgin Metalformers Corp.
Fairchild Camera & Instrument Corp.
Farnsworth Electronics Co.
Federal Telecommunication Laboratories
Federal Telephone & Radio Co.
General Aniline & Film Corp.
General Cable Corp.
General Communications Co.
General Electric Co.
General Telephone Corp.
Gilfillan Bros., Co.
Globe Wireless, Ltd.
Gray Manufacturing Co.
Hallamore Electronics Co.
Haller, Raymond and Brown, Inc.
Hallicrafters Co., The
Haloid Co.
Hazeltine Electronics Division, Hazeltine Corp.
Heinemann Electric Co.
Hercules Motor Corp.
Hitemp Wires, Inc.
Hoffman Laboratories, Inc.
Hogan Laboratories, Inc.
Hoover Electronics Co.
Hopkins Engineering Co.
Hughes Aircraft Co.
Hycon Eastern, Inc.
Illinois Bell Telephone Co.
Indiana Bell Telephone Co.
Indiana Steel & Wire Co.
Institute of Radio Engineers
International Business Machines
International Resistance Co.
International Telephone & Telegraph Corp.
Jacobsen Manufacturing Co.
Jansky & Bailey, Inc.
Kellogg Switchboard & Supply Co.
Kin Tel
Kleinschmidt Laboratories, Inc.
Koiled Kords, Inc.
Lansdale Tube Co., Division of Philco Corp.
Leich Sales Corp.
Lenkurt Electric Co.
Lenz Electric Manufacturing Co.
Lewyt Manufacturing Corp.
Librascope, Inc.
Loral Electronics Corp.
Machlett Laboratories, Inc.
Magnavox Co.
Maida Development Co.
Mallory, P. R., & Co., Inc.
Materiel Telephonique Co.
Michigan Bell Telephone Co.
Montgomery Co., The
Motorola, Inc.
Mountain States Telephone & Telegraph Co.
Mullard Ltd.
Muter Co.
Mycalex Corporation of America
National Co., Inc.
Nelson Technical Enterprises
Nems-Clarke, Inc.
New England Tel. & Tel. Co.
New Jersey Bell Telephone Co.
New York Telephone Co.
North Electric Co.
Northwestern Bell Telephone Co.
Oak Manufacturing Co.
Ohio Bell Telephone Co.
O'Keefe & Merritt Co.
Otis Elevator Co., Electronic Division
Pacific Mercury Television Mfg. Corp.
Pacific Telephone & Telegraph Co.
Packard-Bell Co.
Page Communications Engineers, Inc.
Phelps Dodge Copper Products Corp.
Philco Corp.
Photographic Society of America
Plessey Co., Ltd.
Prodelin Inc.
Production Research Corp.
Radiart Corp.
Radio Condenser Co.
Radio Corporation of America
Radio Corporation of America, Defense Electronic Products
RCA Great Britain, Ltd.
Radio Engineering Laboratories, Inc.
Ramo-Wooldridge Corp.
Raytheon Manufacturing Co.
Red Bank Division, Bendix Aviation Corp.
Reeves Instrument Corp.
Remington Rand, Division of Sperry Rand Corp.
Remler Co., Ltd.
Rocke International Corp.
Saxonburg Ceramics
Society of Motion Picture & Television Engineers
Sonotone Corp.
SoundScriber Corp.
Southern Bell Telephone & Telegraph Co.
Southern New England Telephone Co.
Southwestern Bell Telephone Co.
Sperry Gyroscope Co., Division of Sperry Rand Corp.
Sprague Electric Co.
Stackpole Carbon Co.
Standard Telephone & Cables, Ltd.
Stanford Research Institute
Stelma, Inc.
Stewart-Warner Corp.
Stromberg-Carlson Co., Division of General Dynamics Corp.
Surprenant Mfg. Co.
Sylvania Electric Products, Inc.
Technical Materiel Corp., The
Tele-Dynamics, Inc.
Telephonics Corp.
Teletype Corp.
Tensolite Insulated Wire Co., Inc.
Texas Instruments, Inc.
Times Facsimile Corp.
T.M.C. (Canada) Ltd.
Trad Electronics Corp.
Transitron Electronic Corp.
Triad Transformer Corp.
Tung-Sol Electric, Inc.
Union Carbide Corp.
United Telephone Co.
United Transformer Co.
Waterman Products Co., Inc.
Webster-Chicago Corp., Government Division
West Coast Telephone Co.
Western Electric Co., Inc.
Western Union Telegraph Co.
Westinghouse Electric Corp.
Weston Electrical Instrument Corp.
Wheelock Signals, Inc.
Wickes Engineering & Construction Co.
Wilcox Electric Co., Inc.
Willard Storage Battery Div., Electric Storage Battery Co.
Wisconsin Telephone Co.
Wollensak Optical Co.
Zenith Radio Corp.

E. H. RIETZKE, President, CREI
Capitol Radio Engineering Institute

• *One of a series of institutional messages.*

The President of CREI asks . . .

Can a Technical Institute train the kind of men You need?

THERE are a number of good Technical Institutes. CREI, as one of America's leading Technical Institutes offering ACCREDITED CURRICULA, invites you to answer the above question after reading our ideas on the subject, as expressed below.

1. WHO ACCREDITS THE CURRICULA OF TOP TECHNICAL INSTITUTES? Capitol Radio Engineering Institute curricula have been accredited for a number of years by Engineers' Council for Professional Development, the nationally recognized organization for the accreditation of the curricula of engineering colleges and technical institutes. CREI is a founder member of the National Council of Technical schools which first established strict educational and ethical standards for this important area of technical education. CREI is listed in the U. S. Office of Education Directory, "Higher Education". CREI is authorized by the District of Columbia Board of Education to grant the Degree of Associate in Applied Science.

2. WHAT KIND OF PERSONNEL DO WE TRAIN? Our Institute trains sound, *practical* supporting engineering personnel. This is especially important in view of the growing trend in engineering colleges toward less and less specialization. Their major emphasis is on turning out broadly educated men qualified for basic research assignments. Both are essential and in short supply.

3. ARE TECHNICAL INSTITUTE GRADUATES "TECHNICIANS" OR "PRACTICAL ENGINEERS?" CREI does not claim to turn out "Engineers" in the accepted professional meaning of the term. However, the term "Technician", as very often used in the field and as customarily applied to graduates of technical institutes, in our opinion is not an adequate designation for our graduates. In fact, graduates of CREI start in practical engineering capacities and at average salaries generally comparable to those of engineering college graduates.

4. WHERE ARE TECHNICAL INSTITUTE GRADUATES QUALIFIED TO START? CREI graduates are qualified to start, and do start in industry, in a supporting engineering capacity, in production, design or testing, alongside of graduates of engineering colleges. While the latter may ultimately be of maximum value in research assignments, the technical institute graduate will generally find his most useful role as project engineer, design engineer or field engineer.

5. WHAT IS THE CURRICULUM LEVEL OF OUR TECHNICAL INSTITUTE? It is of college level, and is highly practical in the applications of mathematics and theory with relation to the practical problems encountered in industry.

6. HOW LONG IS THE COURSE OF INSTRUCTION? At CREI three collegiate years are condensed into an average of 28 months. Students attend classes 35 hours per week, 48 weeks per year. All of this time is devoted to practical engineering subjects. Strictly liberal arts subjects are minimized.

7. WHAT ARE THE QUALIFICATIONS FOR ENTRANCE? Students must be graduates of high school, or the real equivalent (to be determined by proper examination) with adequate preparation in mathematics and science. As a matter of fact, at the CREI residence school, students are accepted only through strict aptitude tests. More than half the applicants are rejected by these tests.

8. WHAT DOES OUR TECHNICAL INSTITUTE OFFER TO STUDENTS? We offer an educational program which will equip them in a minimum of time, for happy professional lives in rapidly growing industry, where advancement will be limited only by their own ambition and willingness to work.

9. WHAT DOES OUR TECHNICAL INSTITUTE OFFER TO EMPLOYERS? To employers interested in hiring men who have a sound background in practical engineering and who "can get the job done", we invite you to join the long list of the nation's leading firms who regularly look to us for new technical talent.

You can do a service to your industry, your company, and technically inclined young men, by understanding this type of educational program and recommending it to interested, qualified personnel. We will gladly furnish complete information upon your request.

For your present technical employees, CREI also offers a home study program at the same high level which will fit them for upgrading into technical positions of greater responsibility. Ask us about it.

CAPITOL RADIO ENGINEERING INSTITUTE

ECPD Accredited Technical Institute Curricula
Founded 1927

Dept. 219-D, 3224 Sixteenth St., N.W., Wash. 10, D. C.

AFCEA CHAPTERS—National Director of Chapters: Maj. Gen. Alvin L. Pachynski, USAF

REGIONAL VICE PRESIDENTS

Region A: Henry R. Bang, N. Y. Tel. Co., 140 West St., New York, N. Y. ***New England States, New York, New Jersey.***

Region B: George C. Ruehl, Jr., 2118 St. Paul St., Baltimore, Md. ***Delaware, District of Columbia, Kentucky, Maryland, Ohio, Pennsylvania, West Virginia and Virginia.***

Region C: Ralph S. Grist, So. Bell T&T Co., Atlanta, Ga. ***Southeastern States along Atlantic and Gulf coasts—from North Carolina to Louisiana including Tennessee.***

Region D: Col. George L. Richon, Hq. Fourth Army, Fort Sam Houston, Tex. ***New Mexico, Texas, Oklahoma, Arkansas.***

Region E: John R. Howland, Dage Television Div., Thompson Products, Inc., W. 10th St., Michigan City, Ind. ***Michigan, Indiana, Illinois, Wisconsin, Minnesota, Iowa, Missouri, Kansas, Nebraska, North Dakota, South Dakota, Wyoming, Colorado.***

Region F: Col. Lloyd C. Parsons, 1807 16th Ave., San Francisco, Calf. ***Arizona, Utah, Nevada, California, Idaho, Oregon, Montana and Washington.***

CHAPTERS: PRESIDENTS AND SECRETARIES

ARIZONA: Pres.—Arthur Mudgett, Fort Huachuca. Sec.—Lt. Col. Clarence O. Coburn, P.O. Box 2813, Fort Huachuca.

ATLANTA: Pres.—Lt. Col. Donald L. Adams, Hqs. Third Army, Fort McPherson, Ga. Sec.—Albert J. Cartey, Southern Bell T&T Co., 51 Ivy Street, N.E.

AUGUSTA-FORT GORDON: Pres.—Col. Braxton E. Small, 9600 TU SigTrngCmd, Fort Gordon. Sec.—Lt. Col. William O. Beasley, Hqs. TSESS, Fort Gordon.

BALTIMORE: Pres.—Henry B. Yarbrough, Bendix Radio, E. Joppa Rd., Towson, Md. Sec.—Trevor H. Clark, Westinghouse Electric Corp., Air Arm Div., Friendship Int'l. Airport.

BOSTON: Pres.—Col. Murray D. Harris, PMST, Northeastern University, Boston. Sec.—Louis J. Dunham, Jr., Franklin Technical Institute, 41 Berkeley St., Boston, Mass.

CENTRAL FLORIDA: Pres.—Willard L. Moor, 3002 Fair Oaks, Tampa. Sec.—Russell R. Randell, 22 Garden Drive, Apt. 7. McDill AFB.

CHICAGO: Pres.—Henry J. McDonald, Kellogg Switchboard & Supply Co., 6650 S. Cicero Ave., Chicago 38. Sec.—James F. Weldon, SigC Supply Agency; 615 W. Van Buren St.

DAYTON-WRIGHT: Pres.—Col. S. A. Mundell, ARDC, Wright-Patterson AFB, Ohio. Sec.—Jack G. Anderson, Hoffman Laboratories, Inc., 2600 Far Hills Bldg., Dayton.

DECATUR: Pres.—Maj. Robert M. Burns, 402 E. Prairie, Decatur, Ill. Sec.—Capt. Walter L. Beddingfield, Decatur Signal Depot, Decatur.

FORT MONMOUTH: Pres.—Col. Robert B. Tomlinson, 4 Russel Ave., Ft. Monmouth. Sec.—Harry C. Ross, Box 249, Hillside Rd., Atlantic Highlands, N. J.

FRANKFURT: Pres.—George A. Spear, Engr. Sec., FSA, APO 757, New York. Sec.—Lt. Harry A. Chalekian, 7772 Svc. Co., APO 757, New York.

GULF COAST: Pres.—Ancil Z. Arseneau, 1350 Park Court So., Biloxi, Miss. Sec.—Joseph A. O'Connell, Southern Bell T&T Co., Gulfport, Miss.

GREATER DETROIT: Pres.—Col. James I. Vanderhoof, Hq 30th Air Div., EADF, ADC, Willow Run AF Sta., Mich. Sec.—J. R. Saxton, Michigan Bell Telephone So., 305 Michigan Ave.

HAWAII: Pres.—Col. Wayne L. O'Hern, Hq. PACAF, APO 953, S. F. Sec.—CWO Joseph B. Milligan, Hq. 1810th AACS Group, APO 915, S. F.

KANSAS CITY: Pres.—Lt. Col. G. D. Meserve, USAF (Ret.), 6211 W. 55th St., Mission, Kans. Sec.—Maxwell H. Tyrrell, Southwestern Bell Tel. Co., 6500 Troost, Kansas City, Mo.

KEFLAVIK: Pres.—Maj. John D. Lynch, 1971st AACS Sqdn., APO 81, New York. Sec.—T/Sgt. Donald P. Hall, 1971st AACS Sqdn., APO 81, New York.

KOREAN: Pres.—Col. Walter E. Lotz, SigC, 8th Army, APO 301, S. F. Sec.—Wendell B. Carman, Hqs. KMAG, 8202d AU, APO 102, S. F.

LEXINGTON: Pres.—Lt. Col. R. H. Vinding, Lexington Signal Depot, Lexington, Ky. Sec.—Harold V. Madden, Lexington Signal Depot.

LONDON: Pres.—Lt. Col. John T. Tyler, Hq. Third AF, APO 125, N. Y. Sec.—Capt. H. W. Gipple, Hq. Third AF, APO 125, N. Y.

LOUISIANA: Pres.—Charles Pearson, Jr., Southern Bell Tel. & Tel. Co., 520 Baronne St., New Orleans. Sec.—A. Bruce Hay, Southern Bell Tel. & Tel. Co., 520 Baronne St., New Orleans.

NAGOYA: Pres.—Col. Steve J. Gadler, Hq. 5th AF, APO 710, S. F. Sec.—H. R. Heggen, Box 707, Hq. 5th AF, APO 710, S. F.

NEW YORK: Pres.—Benjamin H. Oliver, AT&T Co., 195 Broadway, New York, N. Y. Sec.—Lt. Col. David Talley, Fed. Tel. & Radio Corp., 100 Kingsland Rd., Clifton, N. J.

NEW YORK UNIVERSITY: Pres.—Robert A. Fisch, 2386 Davidson Ave., New York 68, N. Y. Sec.—Sheldon Brown, 587 Beck St., New York 55, N. Y.

NORTH CAROLINA: Pres.—Lt. Col. Cuggie E. Kyzer, Post SigO, Fort Bragg. Sec.—Col. Henry J. Hort, 1st Log. Comd., Fort Bragg.

NORTH TEXAS: Pres.—H. J. Wissemann, Texas Instruments, 6000 Lemmon Ave., Dallas. Sec.—John W. Williams, 4913 Cockrell Ave., Fort Worth.

NORTHEASTERN UNIVERSITY: 360 Huntington Ave., Boston 15, Mass. Div. A: Pres.—Wilfred J. Picard; Sec.—Thomas R. King, Jr. Div. B: Pres.—Neal W. Atkinson; Sec.—Jason Brooks.

NORTHWEST FLORIDA: Pres.—Col. R. B. H. Rockwell, Hq. APGC, Eglin AFB. Sec.—Capt. Edmund G. Forkner, Hq. APGC, DCS/M-ME, Eglin AFB

ORANGE: Pres.—Fred A. Cullman, Radiation, Inc., 501 Commonwealth Ave., Orlando, Fla. Sec.—Maj. Donald E. Dobbins, Orlando AFB, Fla.

PARIS: Pres.—Br. Gen. Frank W. Moorman, U. S. Army Attache France, APO 230, N.Y. Sec.—Lt. Col. Russell A. Duke, Office of U.S. Army Attache, APO 230, N. Y.

PHILADELPHIA: Pres.—William F. Powell, Jr., Bell Telephone Co., 1835 Arch St. Sec.—Robert G. Swift, Diamond State Telephone Co., 121 N. Broad St.

PHILIPPINE: Pres.—Col. Orville Laird, Hq. Thirteenth AF, APO 74, S. F. Sec.—Robert C. Young, c/o Jay Howe, 2720th Maintenance Gp., APO 74, S. F.

PITTSBURGH: Pres.—George H. Aderhold, Saxonburg Ceramics Co., Saxonburg, Pa. Sec.—H. W. Shepard, Jr., 386 Arden Road.

ROCKY MOUNTAIN: Pres.—Byron E. Thady, Mountain States Tel. Co., 17 N. Weber, Colorado Springs, Colo. Sec.—Capt. Francis D. Tappin, USAF Hq. ADC, Ent AFB, Colo.

ROME: Pres.—Maj. William B. Bodine, Army Sec. MAAG, APO 794, N. Y. Sec.—John E. Colarusso, MAAG Army, APO 794, N. Y.

ROME-UTICA: Pres.—Allan A. Kunze, Lee Center, N. Y. Sec.—Darrell S. Kirby, 904 Floyd Ave., Rome, N. Y.

SACRAMENTO: Pres.—Lt. Col. Clarence M. Godfrey, Sacramento Signal Depot. Sec.—Capt. Robert McMorrow, 951 La Sierra Drive.

SAN FRANCISCO: Pres.—S. N. Barton, Mackay Radio, P. O. Box 1241, Palo Alto, Calif. Sec.—Karel W. Goossens, Pacific T&T Co., 140 New Montgomery St.

SAN JUAN: Pres.—Wyman S. Borden, P. R. Tel. Co., Box 4275, San Juan, P. R. Sec.—Albert Crumley, Radio Corp. of P. R., P. O. Box 10073, Caparra Heights, P. R.

SCOTT-ST. LOUIS: Pres.—Col. Charles W. Gordon, 3310 TTGrp Cmdr., Scott AFB, Ill. Sec.—Allan L. Eisenmayer, P.O. Box 456, Trenton, Ill.

SEATTLE: Pres.—Raymond J. Laine, 521 E. 123rd Sec.—Merrill R. Stiles, 916 W. 122nd.

SOUTH CAROLINA: Pres.—Cmdr. H. C. Rodin, Bldg. 10, Charleston Naval Shipyard, Charleston. Sec.—F. L. Davis, Southern Bell T&T Co., Owen Bldg., Columbia.

SOUTH TEXAS: Pres.—Col. Albert H. Snider, 1822 AACS Group, Randolph AFB, Tex. Sec.—S. J. Keane, Southwest Research Institute, Box 2296, San Antonio.

SOUTHERN CALIFORNIA: Pres.—Lester R. Daniels, Daniels Engineering, Inc., 5244 Van Nuys Blvd., Van Nuys, Cal. Sec.—Col. Frank J. Shannon, Sr., Pacific Mercury TV Mfg. Corp., 8345 Hayvenhurst Ave., Sepulveda, Cal.

SOUTHERN CONNECTICUT: Pres.—Edwin B. Hurley, So. New England Tel. Co., Box 1562, New Haven. Sec.—J. A. Leopold, Dictaphone Corp., 375 Howard Ave., Bridgeport.

SWITZERLAND: Pres.—William P. Lear, Lear Radio, Geneva; Sec.—Robert V. Lindsey, Intl. Telecommunications Union, Geneva.

TINKER-OKLAHOMA CITY: Pres.—Delbert F. Cravens, Southwestern Bell Tel. Co., 405 No. Broadway, Oklahoma City. Sec.—Lt. Col. Albert A. Rudd, 1800 AACS Wing, Tinker AFB, Okla.

TOKYO: Pres.—Col. Thomas W. Riley, Hq. USARJ Sig. Off., APO 343, S. F. Sec.—D. A. L. Hughes (Philco), Hq. USARJ Sig. Off., APO 343, S. F.

WASHINGTON: Pres.—L. Harriss Robinson, Motorola, Inc., 1145 19th St., N.W. Sec.—John R. O'Brien, Hoffman Laboratories, Inc., 1625 Eye St., N.W.

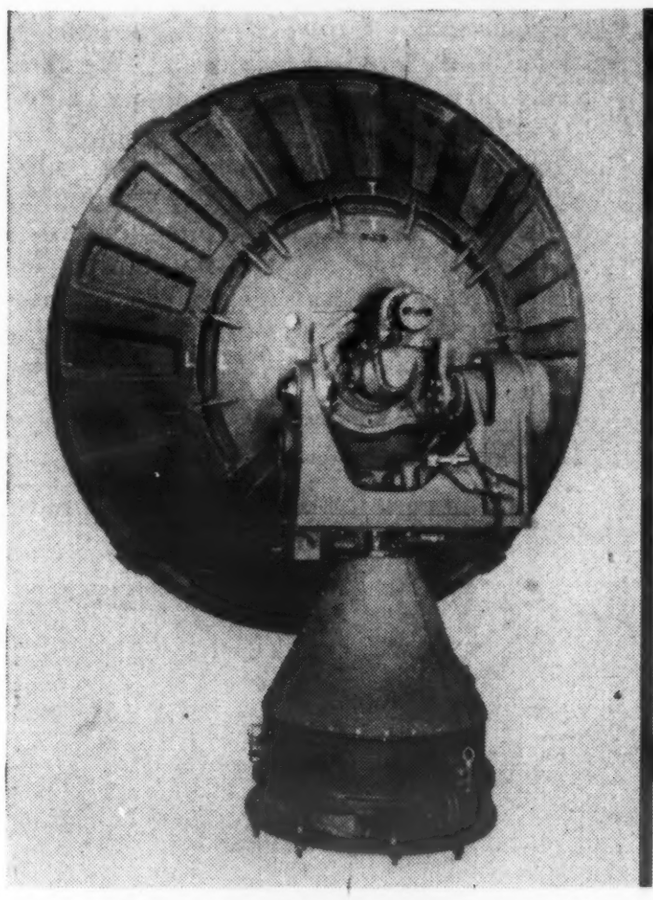
Doubtless you've learned to depend on the Bendix Synchro "Supermarket" for fast delivery and tremendous selection of precision synchros, servo motors and other vital electronics systems components. But did you know that Bendix is also a prolific producer of radar antenna devices?

Over the years Bendix airborne and ground-based antenna devices have been successfully designed by our highly specialized staff of radar and servo-mechanisms engineers to meet a wide variety of exacting requirements. And, of course, world-famous Eclipse-Pioneer precision rotating components are standard in all Bendix radar antenna devices.

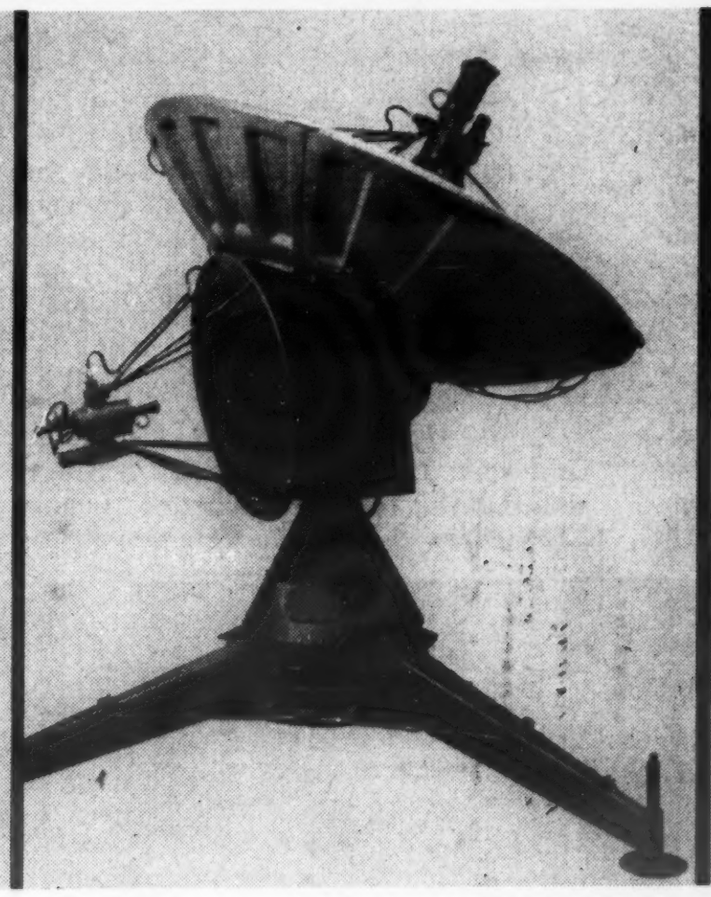
When you order from Eclipse-Pioneer, you'll enjoy the advantages of experienced engineering coupled with favorable delivery and prices that result from mass production techniques.

District Offices: Burbank and San Francisco, Calif., Dayton, Ohio, and Seattle, Wash.—Export Sales and Service: Bendix International Division, 205 E. 42nd St., New York 17, N. Y.

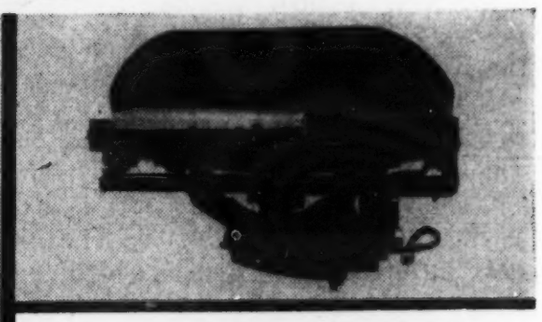
TYPICAL EXAMPLES OF BENDIX RADAR ANTENNA DEVICES



Lightweight, ground-based, air-transportable tracking antenna pedestal for mounting 8-ft. diameter, s-band segmented parabolic reflector and nutating scanner; highly accurate 2-speed data systems in elevation and azimuth.



Lightweight, ground-based, air-transportable, dual reflector, multi-band, high gain search antenna and control system; 2-speed data systems and magnetic clutch drives in azimuth and elevation.



Airborne reflector mounting and drive unit for x-band antenna; 2-speed, continuous rotation in azimuth, either direction; 40° and 60° sector scans; remote manual tilt; line of sight stabilization.

Airborne weather radar antenna with line of sight stabilization for x- or c-band; switchable wide fan (cosecant squared) beam pattern for mapping or pencil beam for storm detection.

Eclipse-Pioneer Division

TETERBORO, N. J.

Bendix
AVIATION CORPORATION

Chapter News

Baltimore

A tour of the U. S. Coast Guard Yard was the feature of the April meeting. Hosts to the chapter were Capt. V. E. Day, Commandant of the Coast Guard Yard, and Lt. Cdr. Joseph G. Bastow, a vice president of the chapter.

The highlight of the tour was an inspection trip aboard the 125-foot experimental boat, the cutter "Cuyahoga," which is used for radio and radar testing programs in the Chesapeake Bay.

Other points of interest were: a light tunnel where tests are made on flashers, timers and other controls used in the operation of beacon lights; a new Ozalid machine; a prototype of an unattended and automatic lighthouse which operates navigational lights and fog horns; testing areas for various types of foreign-made fog horns and for paints; lamp changers which will place a new lamp into burning position in the event of a lamp failure, and batteries for use on shore beacon lights.

On May 16th, the chapter commemorated the occasion of the tenth anniversary of the Marine Corps Battalion in Baltimore. A dinner-meeting at the Park Plaza Hotel was addressed by Maj. Gen. Edward W. Snedeker, USMC. Assistant Chief of Staff G-3. Other distinguished guests were: Brig. Gen. James P. S. Devereaux, USMC (Ret.); Maj. Gen. F. McAllister, USMC, Assistant Chief of Staff G-4; Col. Charles L. Cogswell, USMC (Ret.); Col. Robert Walton, USMC; Mr. A. E. Abel, General Manager of Bendix Radio, and Brig. Gen. Ivan L. Farman, Air Research Development Command.

General Snedeker gave a brief review of the history and mission of the Marine Corps and then discussed the importance of radio and electronic equipment in modern combat. He stated that communications were relatively simple in World War II when Marines made mass, waterborne landings. But in the future, he said, troops using helicopters to land over a wide area will need vastly improved radio communications. He also described progress made by the Marine Corps in electronics research.

Two films completed the evening's program: "Ships from the Sky," showing the part the Marine Corps plays in a vertical assault to provide a beachhead when and where needed, and "Marine Corps and Close Air Support," depicting the importance of the use of helicopters.

The Westinghouse Electric Corporation was host to the chapter at its new electronics plant on June 11th. Mr. B. M. Brown, Westinghouse Vice-President, welcomed the group and gave a resume of the plant's facilities.

Mr. Carl Sersted, Assistant Sales Manager of Electronics, detailed the various departments housed in the plant, namely: X-ray; industrial electronics; maintenance and repair shop; sales office; defense electronics activities consisting of (a) the ordnance group which is responsible for the torpedo system; (b) the air arm group responsible for airborne systems; and (c) the electronics group responsible for ground and shipboard electronics.

A tour of the plant facilities, including the paraballoon antenna, followed.

Nominees for new officers for 1957-58 were submitted by E. Charles Meyenburg, chairman of the nominating committee, and were elected as follows: president—Henry B. Yarbrough, Bendix Radio, who had served in this capacity in 1955-56; vice presidents—LCdr. Joseph G. Bastow, USCG; Col. Timothy McKenzie, USA; LCdr. John Greksouk, USN; Col. Charles L. Cogswell, USMC (Ret.); Emmett T. Loane, Chesapeake & Potomac Telephone Co.; Adam A. Fiedler, Bendix Radio; John M. Pearce, Hoover Electronics, Inc.; Josel M. Jacobson, Aircraft Armaments Corp.; Beaufort M. Brown, Westinghouse Electric Corp.; Brig. Gen. Ivan L. Farman, ARDC; Edwin R. Harrall, Bendix-Friez, and Thomas E. Thompson, Glenn L. Martin Co.; secretary—Trevor H. Clark, Westinghouse Electric Corp.; treasurer—Ray Moore, Hoover Electronics, Inc.; chairman, board of directors—George C. Ruehl, Jr., Electronics Specialties Co. of Maryland, outgoing president.

Boston

Col. Murray D. Harris, Professor of Military Science and Tactics, Northeastern University, was elected president of the Boston Chapter at the recent annual elections.

Other officers were chosen as follows: vice presidents—Frank Lyman, Jr., Cambridge Thermionic Corp., and Robert B. Richmond, General Radio Company; secretary—Louis J. Dunham, Jr., Franklin Technical Institute; treasurer—William Melanson, Cambridge Thermionic Corp.

Board of directors: David R. Hull, Raytheon Manufacturing Co.; Gardiner G. Greene, Browning Laboratories, Inc., and Fred E. Moran, Western Union Telegraph Co., outgoing chapter president.

Committee chairmen were also named. They are: program—Capt. A. R. Taylor, USN (Ret.); membership—Edward R. Chasson, New England Telephone and Telegraph Co.; reception—William Holdich, Boston Naval Shipyard; publicity—Jack Hobby, Raytheon Manufacturing Co.

Dayton-Wright

New officers for the 1957-58 term have been selected as follows:

Baltimore—Shown at the dinner-meeting commemorating the tenth anniversary of the Marine Corps Battalion in Baltimore are, left to right: Mr. A. E. Abel, General Manager of Bendix Radio; Brig. Gen. James P. S. Devereaux, USMC(Ret.); Maj. Gen. F. McAllister, USMC; Maj. Gen. Edward W. Snedeker, USMC, guest speaker, and George C. Ruehl, Jr., chapter president.

Arnold Magnetic Materials

. . . the most complete line in the industry

PERMANENT MAGNET MATERIALS

Cast Alnico Magnets

Sintered Alnico Magnets

Vicalloy

Cunife

Arnox III

HIGH PERMEABILITY MATERIALS

Tape Wound Cores of Deltamax, Supermalloy, Permalloy

"C" and "E" Cores of Silectron

Bobbin Wound Cores

Molybdenum Permalloy Powder Cores

Iron Powder Cores

Sendust Powder Cores

Special Magnetic Materials

PRECISION-TESTED TO YOUR SPECS . . .

Arnold magnetic materials can answer all your requirements. It is the most complete line in the industry; and in addition, Arnold maintains complete control over every production step from raw materials to finished products.

Typical testing of Molybdenum Permalloy Powder Cores is illustrated above. Precision equipment and methods such as these accurately measure the properties of all magnetic materials before shipment, insuring ultimate performance in accordance with your specifications.

Such a source can bring you advantages in long experience and undivided responsibility, and in unequalled facilities for quality control and production.

• *Let us supply your needs!*

WSW 6781

THE ARNOLD ENGINEERING COMPANY

Main Office & Plant: Marengo, Illinois

Divisional Sales Offices:

New York: 380 Fifth Ave. Washington, D.C.: 1001 Fifth St., N.W.

Boston and Northeastern University—Fred Moran, president of the Boston Chapter, displays to President Carl S. Ell of Northeastern University and Col. Murray D. Harris, PMS&T at Northeastern and president-elect of the Boston Chapter, the Chapter of the Year Award plaque won by the Northeastern University Student Chapter at the National Convention. Mr. Moran re-presented the plaque at the Annual Spring Awards Ceremony held at Northeastern.

President — Col. S. A. Mundell, Wright-Patterson AFB; vice presidents —W. M. Hilt, General Mills, Inc.; Col. L. J. Israel, Wright Air Development Command; J. W. Kinnally, Philco Corp.; Col. L. N. O'Connor; R. A. Root, Jr., Radio Corporation of America; C. D. Small, Emerson Electric Mfg. Co.; Lt. Col. J. H. Terrell, Jr., WADC; J. Wilkinson, American Phenolic Corp.; secretary-treasurer—Jack G. Anderson, Hoffman Laboratories, Inc.

Fort Monmouth

The executive board of the chapter met on July 23rd for dinner and a business session to formulate plans for the resumption of activities in the fall. Special guest was the new Commanding General of Fort Monmouth, Maj. Gen. W. Preston Corderman, a charter member of the AFCEA and, for the past two years, a vice president of the Washington Chapter.

Col. Robert P. Haffa, Director of the Components Division, USASEL, was appointed to the Board of Directors to replace Col. Olin L. Bell who had been transferred.

Present at the meeting were: Col. Robert B. Tomlinson, president; Halsey F. Hubbard and Norman Freeman, vice presidents; Harry C. Ross, secretary; Col. Paul Langguth, Harry Sundermeyer, Col. Joseph E. Heinrich, J. P. Hoffman, Raymond Gilbarte, Brig. Gen. Earle F. Cook, directors, and Dr. B. Caldwell, representing Director Edward F. Kolar.

Lexington

The program of the chapter's May meeting was presented by the General Telephone Company of Kentucky and the Automatic Electric Sales Company, and featured a program on the Automatic Teletype Switching Center AN/-FGC-30. Mr. R. E. Stoffels of the Chicago district office conducted the program.

The following new officers were chosen during the annual elections: president—Lt. Col. Randolph H. Vinding, Deputy Commanding Officer, Lexington Signal Depot, and a former president of the North Texas Chapter; executive vice president—Charles L. Morrison, General Telephone Co. of Kentucky; vice president—Dr. Zygmunt S. Gierlach, Central Baptist Hospital; secretary—Harold V. Madden, Lexington Signal Depot; treasurer—Merrill L. Whitmer.

London

A meeting of the executive committee was held at the Columbia Club on July 31st. The purpose of the luncheon-meeting was to establish a tentative schedule of meetings for the coming year and to organize three working committees.

The program committee will be headed by Sir Reginald Payne-Gallwey and the membership committee chairman will be Maj. Fred E. Stant, USAF, chapter treasurer. A publicity committee, whose function will be to publicize the London Chapter activities in the British communications-electronics trade papers and publications, was also organized.

Louisiana

Civil Defense was the theme of the chapter's August 5th meeting, with Col. W. J. Given, Office of Civil Defense, State of Louisiana, as the guest speaker. His subject was "Problems of Communication Planning for the State of Louisiana."

The dinner-meeting was held at the Naval Air Station and was preceded by a social hour.

San Francisco

The Lenkurt Electric Company, second largest manufacturer of telephone and telegraph carrier equipment, was host to the chapter on July 25th, with 100 members and guests present.

Following a social hour and dinner, Ralph Robertson, Manager of the Military Division at Lenkurt, gave the group a brief history of the company's phenomenal growth since it was formed in 1935. He stated the company now has over 2300 employees, carries on a large research and development program for the Armed Services and recently opened an international division with headquarters at Geneva, Switzerland.

A tour of the company plant at San Carlos covered the engineering laboratories and the manufacturing, testing and shipping departments.

San Juan

The chapter's annual "Ladies' Night" meeting took place at the Officers Club of Fort Brooke on June 27th.

Sixty-five members, wives and guests enjoyed their choice of charcoal-broiled steak or filet mignon with all the trimmings. A five-piece combo furnished music for the occasion. The chapter reports the ladies are asking for a "repeat" engagement.

South Texas

The chapter's July 23rd meeting was addressed by Col. Roy D. Maxwell, Medical Service Corps. The dinner-meeting was held at the Fort Sam Hous-

San Francisco—Chapter members pictured during a tour of the Lenkurt Electric Company plant at San Carlos. Left to right: Ralph Robertson; Maj. Gen. James A. Code (Ret.); Scot Robertson of Lenkurt; C. J. Napier, Sylvania Electronics; S. N. Barton, chapter president, and Col. Lloyd C. Parsons, AFCEA regional vice president.

Lexington—Chapter officers and guests at the head table of a recent dinner-meeting are, left to right: Lt. Col. R. H. Vinding, president-elect; E. W. Brown, Jr., exec. vice president; Sam Long, General Telephone Co.; Col. Sterling C. Bush, CO, Lexington Signal Depot; Maj. K. J. Holmes, president; Leith Johnston and R. E. Stoffels of Automatic Electric Co.; Raymond Soard, vice president, and Charles Morrison, General Telephone Co.

ton Officers Club, with members and guests first assembling for a social hour.

Colonel Maxwell, whose current assignment is with the Army Medical Service School at Fort Sam Houston as Special Assistant to the Commandant for Mass Casualty Courses, is classed as one of the foremost authorities in the United States on medical problems of radioactive fallout. He delivered an excellent talk in connection with these problems and those of disaster planning.

Southern California

The annual election of officers was held at the June meeting, with Lester R. Daniels of Daniels Engineering, Inc., chosen to head the chapter during the coming year.

Other new officers are: first vice president—John W. Inwood, Western Union Telegraph Co.; second vice president—Jack Warner, Jr., Warner Bros. Pictures, Inc.; secretary—Col. Frank J. Shannon, Jr., USAF (Ret.), Pacific Mercury Television Manufacturing Corp.; treasurer—Ray E. Meyers, Lockheed Aircraft Corp.

Board of directors: Richard Fuller, Bendix-Pacific; Charles F. Horne, Convair; Loyd C. Sigmon, Radio Station KMPC; C. A. LaHar, Radio Corporation of America, outgoing chapter president; L. D. Callahan, Gilfillan Bros.; John Atwood, Hughes Aircraft; John Byrne, Motorola, Inc.; J. H. Goodrich, Pacific Telephone and Telegraph Co.; Richard Leng, Packard-Bell; James McLean, Hoffman Electronics, Inc.

On August 2nd, the chapter officers were hosts to Rear Adm. Frederick R. Furth, USN (Ret.), new National President of the AFCEA, at a luncheon meeting at the Knickerbocker Hotel, Hollywood. Admiral Furth discussed Association affairs with the group and outlined some of the plans for future activities.

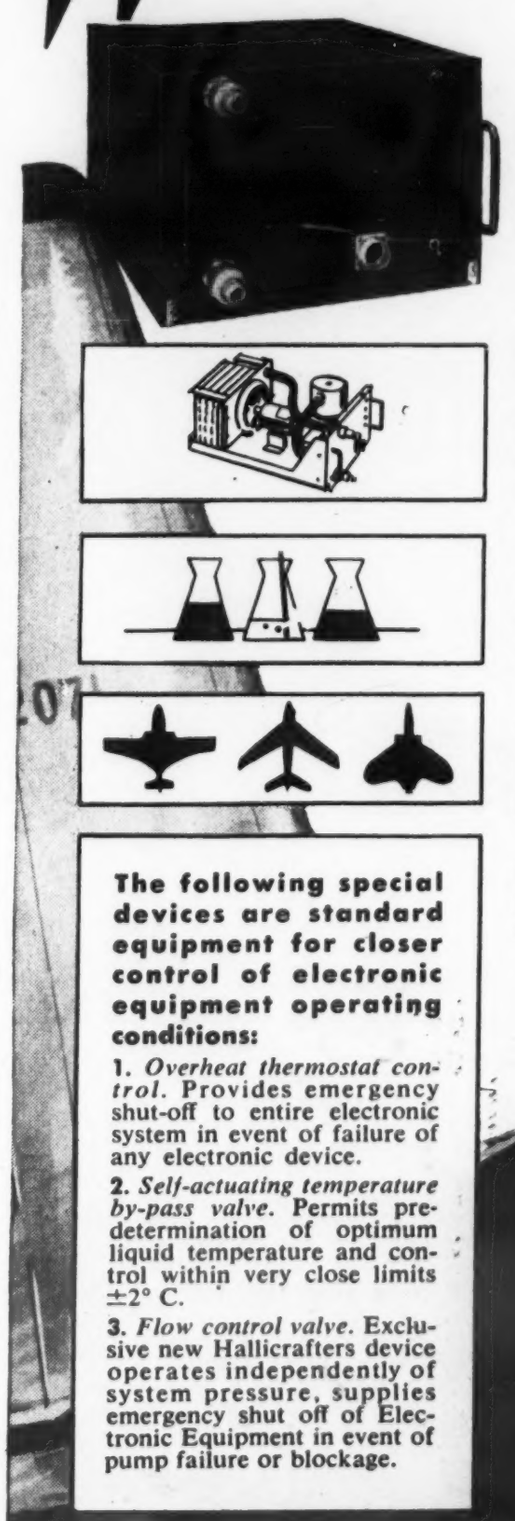
Officers and directors in attendance were: Lester Daniels, John Inwood, Jack Warner, Frank Shannon, Ray Meyers, Loyd Sigmon, C. A. LaHar, John Atwood, John Byrne, J. H. Goodrich and Richard Leng. Guests at the luncheon were: J. A. Frabutt, Federal Telephone and Radio; Russ Smith, Nelson Technical Enterprises; William Cooke, Telemetering Corp.; and Phil Strang, Convair.

Tokyo

The chapter's officers for 1957-58 are: President—Col. Thomas W. Riley, Jr., USA; 1st vice president—Cdr. Ellis Schiller, USN; 2nd vice president—Col. Steve J. Gadler, USAF; 3rd vice president—Frank Colonna, RCA; secretary—Donald A. L. Hughes, Philco Corp.; treasurer—Lt. Col. Robert Brewer, USAF.

New directors of the chapter are: Brig. Gen. Ned Sirmyer, USAF; Brig. Gen. Harold G. Hayes, USA; Col. A. R. Morley, USA; Capt. Robert H. Weeks, USN; Col. Thew J. Ice., Jr., USAF; William Thielz, Bendix Radio; Capt. D. I. Mathers, USN; Col. Roscoe Huggins, USAF; N. Ralph Chaerrigan, DAC, and Paul W. Becker, DAC.

Who put out the "fire" in the tail?



Hallicrafters . . . with a revolutionary, mass produced cooling unit for airborne electronics. Dissipation up to 7,000 watts . . . 20% less costly . . . 30% lighter.

Tested, proven, set for mass production – Hallicrafters new Models CR-2, CR-5 and CR-7 airborne cooling units meet environmental conditions of MIL-E-5272 specification. Revolutionary design permits use of standard racks (CR-7 dimensions: 15⅜" x 19 9/16" x 10⅝") and also accommodates whatever auxiliary gear, such as relays and switches, you may desire.

Vital weight factor is another advantage. For instance: the CR-5 weighs just *30* lbs., is *30% lighter* than conventional 5,000 watt units. And your choice of cooling fluids gives great flexibility of application: silicone oil; ethylene-glycol solution; hydraulic fluid.

Only Hallicrafters fits rated dissipation to *your needs.* Three stock units available – 2,000, 5,000, and 7,000 watts. Design adaptable to intermediate ratings with comparable advantages in cost, weight and performance.

The following special devices are standard equipment for closer control of electronic equipment operating conditions:

1. *Overheat thermostat control.* Provides emergency shut-off to entire electronic system in event of failure of any electronic device.
2. *Self-actuating temperature by-pass valve.* Permits predetermination of optimum liquid temperature and control within very close limits ±2° C.
3. *Flow control valve.* Exclusive new Hallicrafters device operates independently of system pressure, supplies emergency shut off of Electronic Equipment in event of pump failure or blockage.

INVESTIGATE NOW! *If you design, build, purchase, or fly military aircraft . . . if you provide, install or specify airborne electronics . . . write today for complete details.*

Tested and proven in many airborne installations of Hallicrafters electronic equipment.

The hallicrafters Company

4401 W. Fifth Avenue, Chicago, Illinois

CONTRAVES ITALIANA S. p. A.

ROMA

LUNGOTEVERE DELLE ARMI, 12

Stabilimento: VIA TIBURTINA, 965

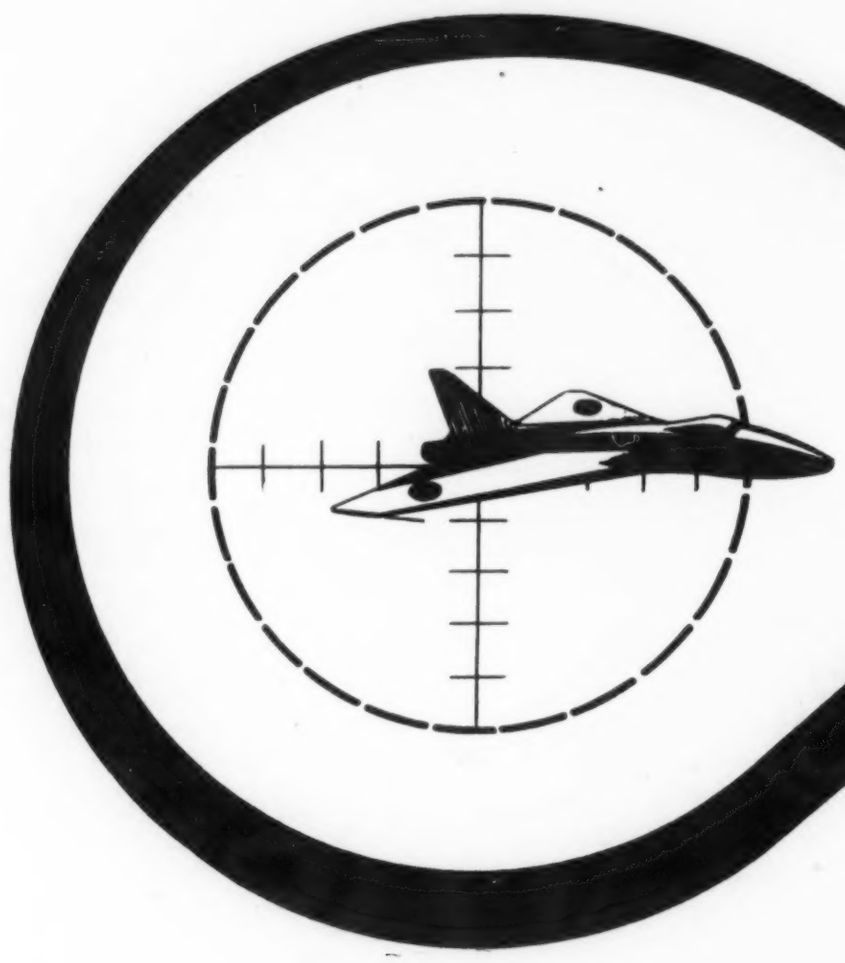
GUN FIRE CONTROL SYSTEMS

GUIDED MISSILES

ANALOG COMPUTERS

SERVO MECHANISMS

MEASURING INSTRUMENTS



CONTRAVES ITALIANA

ITEMS OF INTEREST
From Government, Industry and the Services

Automation On The Battlefield

The U.S. Continental Army Command (CONARC) hopes to bring automation to the battlefield, and preliminary studies indicate that it is feasible to process data electronically in the combat zone.

Military research and development agencies and civilian electronic computer manufacturers are working on the project under the guidance of Colonel Russell L. Hawkins, chief, General Division, Combat Developments Section.

According to Colonel Hawkins, by 1970 the battlefield commander will use automation to completely "war-game" his plans and orders before committing troops to combat. A computer will be able to indicate to him the probable results of his planned course of action.

The machine, Colonel Hawkins cautioned, can only give a commander the consequence of his decisions. "It can't predict the outcome," he said, "because as humans, we can't predict all the variables."

The automation project was inaugurated about a year ago to determine if electronic computing is compatible to combat conditions in three broad fields.

(1) Obtaining ultraswift information on available fire power, supplies and staff estimates.

(2) Removing as many non-combat troops as possible from the main battle position.

(3) Improving reaction time between front and rear units and within units themselves.

Atomic Produced Power

During recent tests of the nuclear reactor and auxiliary components, electric power was produced for the first time by heat from the Sodium Reactor Experiment (SRE). The venture marked the initial production, from a non-military atomic energy reactor, of power for the generation of electricity by a private utility company.

Designed and built for the AEC by Atomics International, a division of North American Aviation, Inc., the SRE is a part of the commission's program to develop economically competitive civilian power from nuclear energy.

The Southern California Edison Co. installed electrical generating equipment, adjacent to the nuclear reactor, to convert reactor heat energy to electricity. The company purchases this power from the AEC.

Following numerous tests to evaluate the operation of all components, the plant will function at full power late this year. The reactor is designed to produce 20,000 kilowatts of heat from which the Edison equipment will generate approximately 6,500 kilowatts of electricity.

A huge, lead-shielded chamber for loading uranium fuel into the atomic energy reactor hovers over the "core" or heart of the reactor sunk deep beneath the ground. Heat from the atomic "furnace" is used by the experimental power station to generate electricity.

Signals Bounced Off Moon

The Navy's highly sensitive Minitrack radio tracking equipment at Blossom Point, Md., has picked up signals bounced off the moon.

Using the giant radar transmitter, "Diana," Army Signal Corps engineers bounced signals off the moon which were picked up by the Maryland station.

The Blossom Point Minitrack Test Facility, operated by engineers from the Naval Research Laboratory, has conducted several successful test "pick ups." The experiments are executed in cooperation with engineers at the U.S. Signal Engineering Laboratories, Fort Monmouth, N. J.

Purpose of the procedure, the Navy said, is to perfect a technique to test Western Hemisphere satellite tracking stations as soon as they are completed and placed in operation.

The Navy's Blossom Point Test Facility is the first radio tracking station to be erected for detecting and measuring the path of the scientific earth satellite as well as for obtaining other information.

Located about 40 miles south of Washington, D. C., the station is one of 10 planned for operation during the International Geophysical Year. It is operated by Project Vanguard personnel of the U.S. Naval Research Laboratory as part of the National Academy of Sciences earth satellite program.

Synthetic Mica Melt

Various Government agencies and manufacturers of high-temperature electrical and electronic equipment are watching with interest recent developments concerning the largest successfully completed commercial melt of Synthamica synthetic mica. Synthetic mica is superior to the natural material for applications involving temperatures in excess of 1000 degrees Fahrenheit.

Experiments are being conducted by the Synthetic Mica Corporation, a subsidiary of Mycalex Corporation of America, at its plant in Caldwell Township, N. J.

After approximately three weeks of cooling, the huge mass of crystalline mica will be broken up and then ground or split into useable form. It is too early to tell what progress has been made, but crystals as large as 4 x 4 inches have been produced consistently in the past.

The synthesis of this strategically important material had been brought to pilot plant production in Germany during the war, when the Axis countries were cut off from sources of natural mica in India and elsewhere. They consequently found their electrical and electronics development severely curtailed.

Foreseeing similar possibilities, the United States Government, through the U.S. Bureau of Mines and various industrial participants, initiated a program at Norris, Tenn., for the commercial production of synthetic mica.

In 1953, Mycalex Corporation of America entered into a cooperative agreement with the Bureau of Mines

to produce the material, and at the conclusion of the agreement built plant facilities and became the only commercial producer of Synthamica synthetic mica.

Proposed "Aerial Jeep"

Recent developments in direct lift devices have prompted the Army to undertake the development of an "aerial jeep." Consequently, the Department of the Army has awarded three contracts, totalling $1,702,000, for the design, construction and testing of flying research vehicles.

The contracts were awarded to Aerophysics Development Corporation, Santa Barbara, California ($388,000); Chrysler Corporation, Detroit, Michigan ($661,000), and to the Piasecki Helicopter Corporation, Philadelphia, Pennsylvania ($653,000).

The "aerial jeep" concept seeks to provide the Army with a compact vehicle having the versatility of a conventional jeep together with added hovering and self-propellent capabilities.

Ultimately the Army hopes to have a general purpose vehicle which can travel 50 miles per hour, stay in the air for several hours, and carry up to 1,000 pounds of equipment.

The small vehicle size is obtained through utilization of ducted propeller vehicles in forward flight and to determine the most promising control system. Different arrangements and configurations of ducted propellers and control systems will be investigated under the three contracts.

Firm to Specialize in Scatter

Controlling interest in Scatter Communications, Inc., Bethesda, Md., has

Lester H. Carr

been acquired by L. H. Carr and Associates of Washington, D. C.

The recently formed company specializes in the design, engineering and installation of complete scatter radio communications systems or components.

Scatter Communications, Inc. was organized earlier this year by a team of executives, engineers and support personnel. Prior to incorporating their own firm, this group engineered and supervised the installation of the Air Force's North Atlantic Scatter Circuit.

Officers of the company are: Lester H. Carr, chairman of the Board of Directors; Harry M. Tayloe, president; Clifton F. Foss, executive vice president; William E. Yost, Jr., vice president-engineering and F. L. McCutchen, project manager.

Air Force Reveals Falcon GAR-2A

The Falcon GAR-2A, a new guided missile based on detection of infra-red radiation, is now in operation as a U.S. Air Force defense weapon. This armament is the latest in the GAR (guided aircraft rocket) series of air-to-air missiles produced as all-weather interceptors of the Air Defense Command.

Secret of the weapon's operation is its revolutionary guidance unit which senses, at a distance of miles, the infra-red radiation (IR) thrown out by invading aircraft.

Before the 2A is launched, the missile's IR guidance unit is "slaved" to the target by the radar armament control system of the interceptor. The unit sends signals to the Falcon's control mechanism and, when launched, the missile seeks out the target by steering toward the discerned source of radiation. The IR detector is so sensitive that a guided rocket propelled miles from a target will "lock on" and fly at tremendous speed to intercept and destroy it.

The 2A can be launched far below an enemy craft and will climb, surpassing supersonic speed, to an altitude higher than the operational ceiling of any known bomber.

News of the missile's operational use was disclosed jointly by the Air Force and Hughes Aircraft Company.

E.C.I. Organizes Reliability Section

Due to the growing concern of the military with product dependability, Electronic Communications, Inc., Teterboro, N. J., has organized a Reliability Assurance Section.

The new department, one of the first in industry pertaining entirely to this area, brings together the following groups: test equipment, qualification testing, component evaluation, and reliability and environ-

(Continued on page 68)

UNEQUALED PERFORMANCE IN

- TELEMETERING
- GUIDED-MISSILE MONITORING
- RADIOSONDE RECEPTION

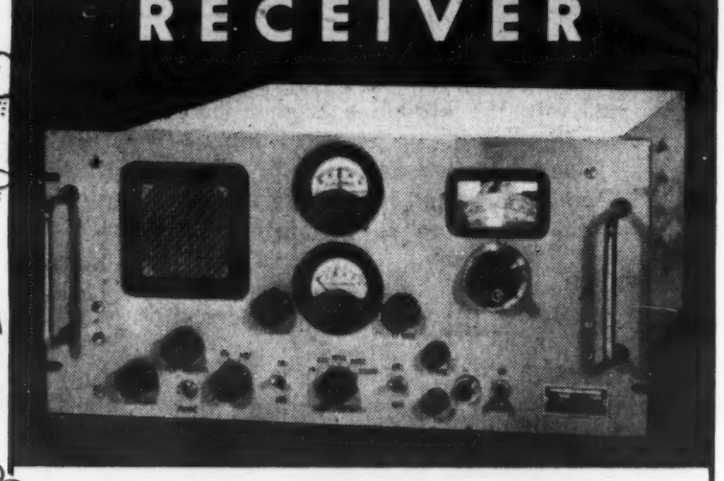
This Special Purpose Receiver is an improved version of the NEMS-CLARKE 167-J1 and 167-J2. This new Receiver incorporates the best qualities of both of the former types plus many new features including a BFO. A video bandwidth control is provided to greatly improve signal-to-noise ratio when full bandwidth is not needed. It is especially useful as a high quality general purpose laboratory receiver.

NEMS-CLARKE

A DIVISION OF VITRO CORPORATION of AMERICA

919 JESUP-BLAIR DRIVE
SILVER SPRING, MARYLAND
For further information write Dept. H-14

TYPE 1501 SPECIAL PURPOSE RECEIVER



SPECIFICATIONS

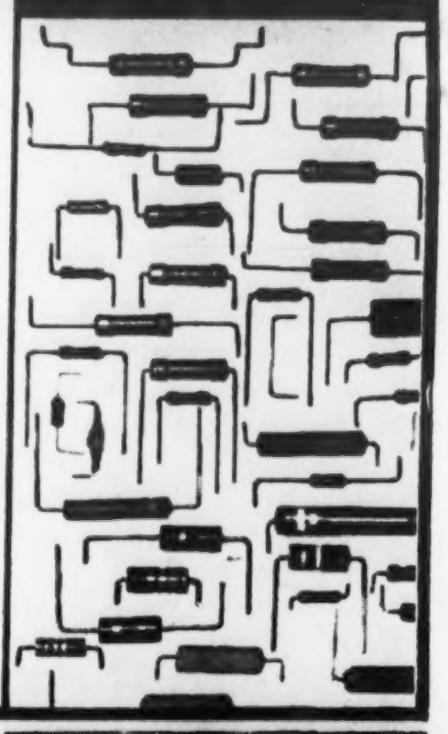
Type of reception	AM, FM, or CW
Tuning range	55-260 mc
IF bandwidth	300 kc
Sensitivity (measured without band-restricting filters)	8 uv produces at least 23 db S/N ratio with 100-kc deviation, 400-cycle modulation.
Noise figure	11 db, maximum
IF rejection	Not less than 70 db
Image rejection	Not less than 40 db below 130 mc; 30 db minimum at any frequency.
FM output	0.15 volt per kc deviation (Approx.)
AM output	12 volts for 10 uv input modulated 30% at 1000 c.p.s. (Approx.)
Squelch	Operates on monitor circuit

PROVEN-on the assembly line!

"PIG-TAILOR"* T.M.

For PREPARATION of axial lead components

PREPARED COMPONENTS IN SECONDS WITH THE "PIG-TAILOR"



"PIG-TAILORING"

. . . . a revolutionary new mechanical process for higher production at lower costs. Fastest PREPARATION and ASSEMBLY of Resistors, Capacitors, Diodes and all other axial lead components for TERMINAL BOARDS, PRINTED CIRCUITS and MINIATURIZED ASSEMBLIES.

The "PIG-TAILOR" plus "SPIN-PIN"—accurately MEASURES, CUTS, BENDS, EJECTS & ASSEMBLES both leads simultaneously to individual lengths and shapes—3 minute set-up—No accessories—Foot operated—1 hour training time.

PIG-TAILORING provides:

1. Uniform component position.
2. Uniform marking exposure.
3. Miniaturization spacing control.
4. "S" leads for terminals.
5. "U" leads for printed circuits.
6. Individual cut and bend lengths.
7. Better time/rate analysis.
8. Closer cost control.
9. Invaluable labor saving.
10. Immediate cost recovery.

PIG-TAILORING eliminates:

1. Diagonal cutters!
2. Long-nose pliers!
3. Operator judgment!
4. 90% operator training time!
5. Broken components!
6. Broken leads!
7. Short circuits from clippings!
8. 65% chassis handling!
9. Excessive lead tautness!
10. Haphazard assembly methods!

"SPIN-PIN"* T.M. Close-up views of "SPIN-PIN" illustrate fast assembly of tailored-lead wire to terminal.

* PATENT PENDING

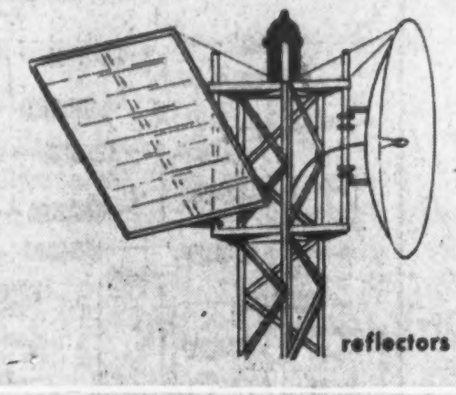
Write for illustrated, descriptive text on "PIG-TAILORING" to Dept. S-9P

BRUNO-NEW YORK INDUSTRIES CORPORATION

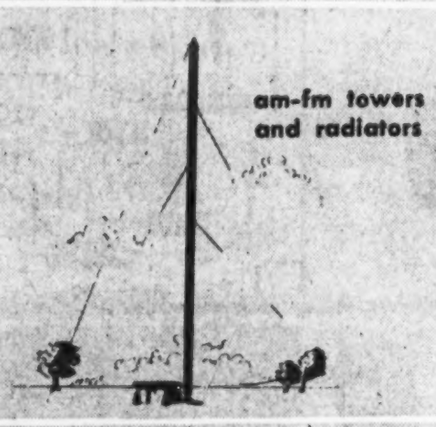
DESIGNERS AND MANUFACTURERS OF ELECTRONIC EQUIPMENT

460 WEST 34th STREET • NEW YORK 1, N. Y.

In Microwave Towers and Reflectors . . . . .

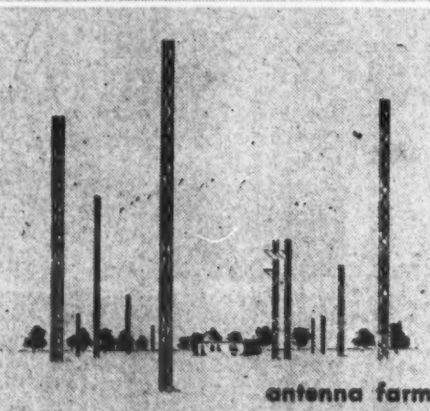


reflectors



am-fm towers and radiators

high gain corner reflector antennas



antenna farms

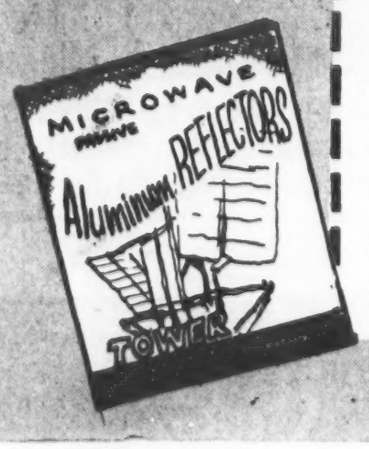
. . a Company is known by the companies that KEEP IT!

Mid-Continent Broadcasting Co.
Television Station KSAZ
Radio Station KFYR
Radio Station WWTV
Amalgamated Wireless Ltd., Australia
Collins Radio Co.
General Electric
Lenkurt Electric Co.
Motorola, Inc.
Page Communications Engineers, Inc.
Philco Corp.
Radio Corporation of America
Raytheon
Western Electric
American Telephone & Telegraph Co.
Bell Telephone Laboratories
Colorado Interstate Gas Co.
Michigan Bell (SAGE project)
Mid Valley Pipe Line
Ohio Power Co.
Southwestern Bell Telephone Co.
U.S. Air Force

tower fabricators and erectors the world over

TOWER
CONSTRUCTION CO.
SIOUX CITY, IOWA

WRITE TODAY for Free BOOKLET



TOWER CONSTRUCTION CO.
2704 Hawkeye Dr., Sioux City, Iowa

Please send me FREE copy of "Aluminum Reflectors"

Name .....
Firm .....
Address .....
City ..... State .....

ITEMS OF INTEREST

mental testing. To be staffed ultimately by 40 scientists and technicians, the section will be headed by G. Wendell Carr, head of test engineering for ECI.

"Heretofore, in common with most contractors for the military, reliability testing has been performed on a less integrated basis at ECI," said Clyde Councilman, chief engineer for the company. "The formation of the new Reliability Assurance Section makes that activity just as important a part of our operations as our research and development effort."

He further remarked that improved reliability is essential in order to reduce the large number of aborted missions, destroyed aircraft and pilot fatalities which have risen to alarming proportions throughout the world.

Charactron Tube Developed

A Charactron shaped beam tube has been developed which is small enough for aircraft use, and yet able to reproduce a conventional radar display map and then print labels on it.

The new developmental product was announced by Stromberg-Carlson, San Diego, a division of General Dynamics Corporation.

The Charactron shaped beam tube accomplishes the dual function of a radar tube and a tube displaying characters by means of time sharing. The characters are printed on the phosphor screen at the rate of 20,000 a second and retained by the phosphor while the electronic device does its radar work in between letters and numbers.

The tube can be used:

(1) For radar displays combined with character and numeral printing to label the objects shown on radar.

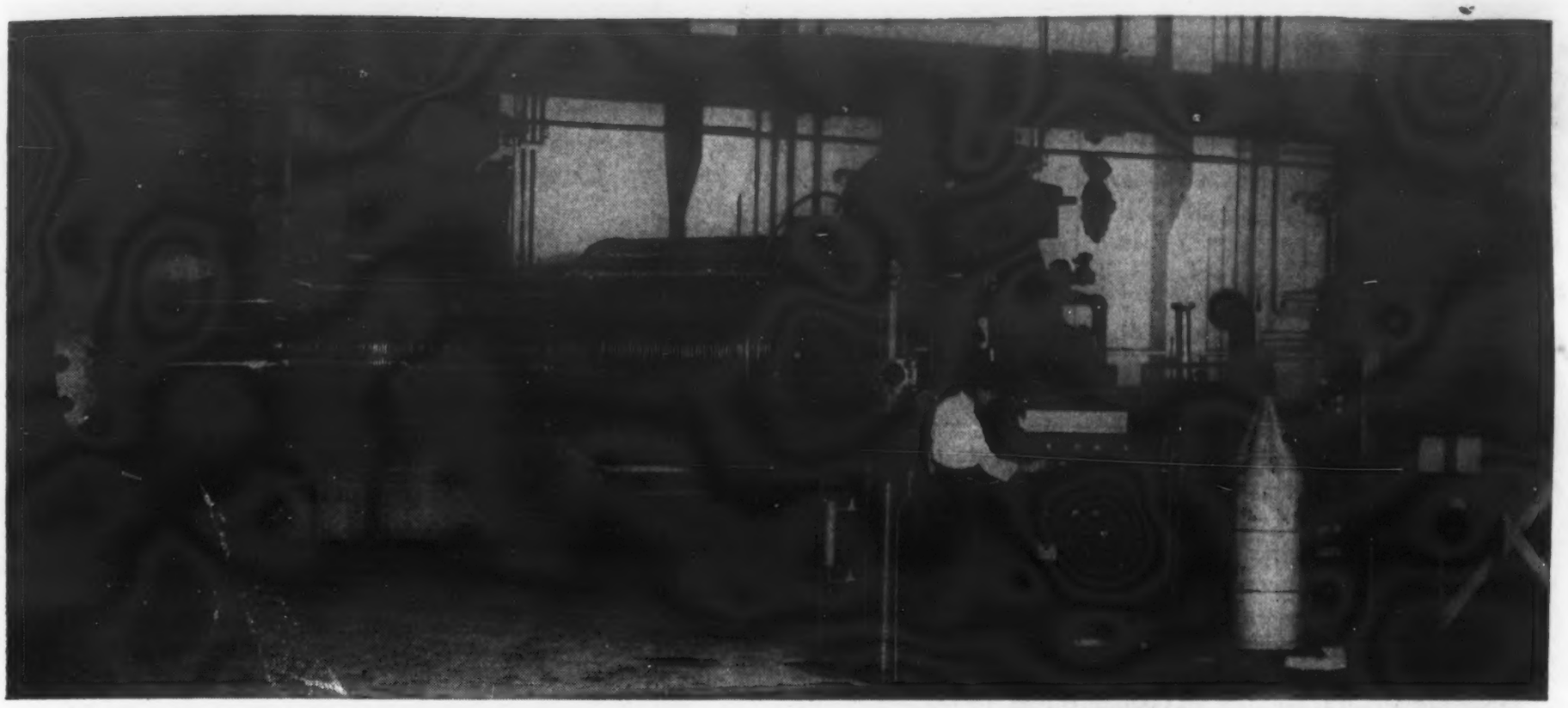
(2) To condense flight data for a pilot. Instrument panels on some multi-engine aircraft must show an extensive array of constantly changing speeds, pressures and other data for each engine. All of this information can be consolidated and displayed in easy-to-read graphic and digital form by the new tube.

(3) To display command instructions from a ground data source aboard an aircraft.

(4) To display navigational information from an airborne computer by reproducing moving maps and symbols in a form which the pilot can read and understand quickly.

(5) In models for shipboard use to perform aircraft and ship surveillance now done at ground stations by larger models of the Charactron shaped beam tube for the SAGE system.

(*Continued on page* 70)



Van de Graff accelerator in ONR's Naval Research Laboratory. Many substantial contributions in the field of nuclear physics have been made by ONR scientists.

U. S. Navy Photo

OFFICE OF NAVAL RESEARCH BRINGS SCIENCE OF FUTURE TO AMERICA'S SEA ARM

The Office of Naval Research, formed in 1946, has already become an extremely important contributor to the effectiveness of the Navy and a full-fledged member of the scientific community. ONR's mission is "to plan, foster, and encourage scientific research . . . as related to the maintenance of future naval power and the preservation of national security . . ."

The Navy has an enormous requirement for nearly every kind of scientific and technological information. Since its establishment, ONR has supported scientific research in nearly every major scientific field. Its research results support development in Navy bureaus, in aircraft, guided missiles, ships, medicine, training, logistics and other areas. ONR also supports exploratory development to test the feasibility of radically new weapons concepts.

Most ONR research is performed under contract in universities, non-profit institutions, and industrial laboratories. Research is also performed at the four laboratories under ONR supervision: the Naval Research Laboratory, the Training Device Center, the Underwater Sound Reference Laboratory, and the U. S. Naval Biological Laboratory.

Out of ONR's laboratories have come such developments as the earliest radar; major advances in radio telescopy; high altitude research (employing both balloons and rockets, such as the well-known Viking); many contributions in nuclear physics, nuclear power, metallurgy, mechanics, and chemistry; advances in physiology, biology, and psychology as well as an extremely wide range of developments in weapons controls, armament, amphibious warfare systems, underwater ordnance, aircraft instrumentation, undersea warfare—and in many related fields.

Typical of ONR's latest work is logistic support of the Earth Satellite Program, being carried on by ONR's Naval Research Laboratory. The entry of the satellite into space should bring many contributions in physics, geodesy, and geophysics, with many long range applications in transportation, communications, meteorology, navigation, mapping—and space travel.

This is one of a series of ads on the technical activities of the Department of Defense

FORD INSTRUMENT CO.
DIVISION OF SPERRY RAND CORPORATION
31-10 Thomson Avenue, Long Island City 1, New York
Beverly Hills, Cal. • Dayton, Ohio

ENGINEERS of unusual abilities can find a future at FORD INSTRUMENT CO. Write for information.

Engineer at Ford Instrument checks out computer developed and built for U. S. Navy.

ITEMS OF INTEREST

Rixon Becomes Independent

Rixon Electronics, Inc., a research and development firm of Silver Spring, Md., has become an independent company. James L. Hollis will serve as the new president.

The firm was formerly a subsidiary of Page Communications Engineers, Inc., Washington, D. C. The change was made through a stock transfer in which Mr. Hollis relinquished his interest and resigned as an executive in the Page concern.

Organized primarily for the purpose of developing prototype models of electronic equipment, Rixon has designed and produced equipment of all sizes.

Most of the efforts to date have been concentrated on specialized equipment for use in scatter communications. Special purpose test and monitoring equipment, antenna preamplifier stages, special purpose exciters, and various components of terminal or interconnect equipment developed by Rixon are in service today in important scatter communications circuits.

Two successful major developments are the TX-264 60 Kw VHF Transmitter and the MUX-16 (An/TCC-35) Sixteen Channel Teletypewriter Multiplex System. Both were developed under contracts with MIT Lincoln Laboratory and Page Communications Engineers, and prototypes are now in service in Department of the Air Force installations.

Starting with three employees when first organized five years ago, Rixon now employs over 100 people.

Names In The News

Brigadier General Kenneth F. Zitzman has recently been named to the high post of Deputy Commandant of the Industrial College of the Armed Forces, Fort McNair, Washington, D. C.

Harry M. Stephey has joined the General Electric Company as manager of advanced sales for the Missile Guidance Section of the company's Heavy Military Electronic Equipment Department in Syracuse, New York. For the past several years, Mr. Stephey has been Government field sales manager in Washington, D. C., for Philco Corporation's Government and Industrial Division.

The late **Vernon B. Bagnall** received a posthumous recognition recently when the Canadian government named a lake on the western coast of Melville Peninsula in his honor. Mr. Bagnall, who died of a heart attack on April 10, 1956, was project manager of the Distant Early Warning Line, built for the U. S. Air Force by the Western Electric Company. In this position, which he held from December 1952 until January 1956, he directed the initial planning and construction of the chain of radar stations spanning the North American Continent's northern rim inside the Arctic Circle.

Rear Admiral George Dufek, USN (Ret.), has been designated U. S. Antarctic project Officer by direction of the President. He also will continue as Commander of Task Force 43, the logistic support force known as Operation Deep Freeze III, until completion in 1959 of the Navy's Antarctic participation in the International Geophysical Year.

Dr. William H. Martin, Director of Research and Development, Department of the Army, was awarded the degree of Doctor of Science by The Johns Hopkins University in June. Part of the citation read: "Following his retirement from the Bell System, he entered the service of the Government as Deputy Assistant Secretary of Defense and then in a precedent-breaking decision, he became the first civilian head of research and development for the United States Army by appointment to the post of Director of Research and Development for the Department of the Army."

George W. Bailey, Executive Secretary of IRE, has been appointed adviser and consultant on telecommunications matters to C. Douglas Dillon, Deputy Undersecretary of State for economic affairs. During World War II, he served in many key capacities with the Government and for his contributions to the war effort he was awarded the President's Certificate of Merit. Mr. Bailey is a former National President of AFCEA and is now a National Director.

Brackett K. Thorogood retired as Executive Director of Franklin Technical Institute on June 30. He is succeeded by **Louis J. Dunham, Jr.**, who has been a member of the faculty of the Institute since 1948.

Major General Rodney Smith, USA, has become a member of AFCEA. Upon retirement last month, he joined the ranks of International Telephone and Telegraph Corp., and will head their European office with his headquarters in Paris.

HUNTER

HEATING SYSTEMS

FOR MILITARY APPLICATIONS

Hunter heating systems are used for a wide variety of military applications. They are standard heating and winterization equipment for many types of mobile shelters, military engines, generator sets, etc. and are designed to conform to military multi-fuel requirements.

HUNTER SPACE HEATERS

for mobile or portable military shelters, for radio, radar and guided missile control and maintenance installations.

HUNTER ENGINE HEATERS

for starting internal combustion engines at sub-zero temperatures, for trucks, generator sets, air compressors, etc.

HUNTER SPX TORCHES

for a wide range of applications at sub-zero temperatures. An unpowered open flame burner capable of being lighted with a match and operated on conventional fuels at temperatures down to 90° below zero. Capacity range—from 15,000 to 200,000 BTU.

Write for Folder FB-N156 "Hunter Development and Production Facilities"

HUNTER Manufacturing Co.
30531 Aurora Rd., Solon, Ohio
Heating and Refrigeration Systems

TYPE AK
Input voltage 6 to 230. VA output capacity up to 250. 3600 rpm.
TYPE BK
Input voltage 12 to 230. VA output capacity up to 600. 3600 rpm.
TYPE CK
Input voltage 28 to 230. VA output capacity 750 to 1500. 3600 rpm.

Make SANGAMO your regular source for Rotary Converters

FOR COMMERCIAL AND MILITARY

Sangamo manufactures a complete line of Rotary Converters for commercial, military, or special purpose applications. Three basic models are available in an extended range of electrical characteristics. All units are designed to provide truly dependable power. They are conservatively rated—built to withstand much tougher service than required with big reserves in every detail of design.

DELIVERY TO MEET YOUR SCHEDULES

The modern accelerated production techniques used in Sangamo's new "controlled conditions" factory in Pickens, South Carolina aid in fulfilling all delivery schedules. This new plant is equipped for full capacity production of Rotary Converters, Dynamotors. Generators, and Special DC Motors. Specify Sangamo for *dependable* units and *dependable* delivery.

ENGINEERING HELP FOR APPLICATION PROBLEMS—Sangamo's Engineering and Technical Staff is glad to help any organization with power supply planning. An engineering analysis and recommendations for power supply units to meet your special application are yours for the asking.

There's a Sangamo Rotary Converter for every requirement. Write today for your file copy of Bulletin 1520.

SG57-4

SANGAMO
Electric Company
SPRINGFIELD, ILLINOIS

TUNG-SOL HERMETICALLY SEALED ALLOY JUNCTION PNP GERMANIUM TRANSISTORS

HIGH POWER TRANSISTORS

	Ratings (25°C)		Typical Switching Application (25°C)			
	Vc	Pc	Ecc	Switching Power	Load Current	Switching Power Gain
TS612	−40 V.	15 W.	−14 V.	26 W.	2 Amps.	24 db
TS613	−80 V.	15 W.	−28 V.	52 W.	2 Amps.	23 db
TS614	−60V.	15 W.	−28 V.	54 W.	2 Amps.	29 db

These POWER SWITCH types are designed and tested for low speed switching applications where high power handling capacity is required. Emphasis is given to efficient thermal design and close control of characteristics significant to "on-off" pulsed operation.

Type TS176 is a high POWER AUDIO transistor designed for Class "A" or Class "B" service in power amplifiers. Emphasis is given to efficient thermal design, high power sensitivity and low distortion at high current levels.

MEDIUM POWER TRANSISTORS

	(Ratings 25°C)		(Typical Class B Operation 25°C)			
	Vc	Pc	Ecc	Power Output	Distortion Max.	Power Gain
TS616	−25 V.	150 MW	−12 V.	500 MW	5%	28 db
TS617	−25 V.	150 MW	−12 V.	500 MW	5%	31 db
TS618	−25 V.	150 MW	−12 V.	500 MW	5%	34 db

These 150 milliwatt Transistors are designed and tested for medium power Class "A" or Class "B" audio applications. Close parameter control, particularly at high collector currents, makes special matching within type classification unnecessary. The units are also suitable for industrial control and switching applications.

The Tung-Sol Transistor product line includes a wide variety of general purpose types such as 2N63, 2N64 and 2N65. Special purpose types are also available with specifications directed toward particular applications. Improved high frequency transistors for computer and radio use will be available soon.

SEMICONDUCTOR DIVISION

Tung-Sol Electric Inc., 95 Eighth Avenue, Newark 4, N. J.

TUNG-SOL®

ELECTRON TUBES · SEMICONDUCTOR PRODUCTS

PERSONNEL CLEARING HOUSE

AFCEA Members Available to Industry

The pages of SIGNAL are open to active AFCEA members who are seeking positions in the communications, electronics and photographic industries. Any member is entitled to space free of charge in this column for three issues of the magazine. Please limit your notice to five lines. In replying, employers are asked to address: Box ——, SIGNAL, 1624 Eye Street, N. W., Washington 6, D. C. Letters will be forwarded to the AFCEA member.

MANUFACTURERS LIAISON REPRESENTATIVE. Retired Lt. Colonel, Communications-Electronics Officer with twenty-one years experience. Education: Electrical Engineering and Business Administration. Familiar with Operational Suitability Testing and R & D. Desires to represent manufacturers or act as liaison for companies conducting business with Eglin Air Force Base, Florida. Box 126.

MANUFACTURERS REPRESENTATIVE with over sixteen years experience, partly as a USAF employee, in negotiating and liaison engineering of contracts with the USAF at Wright Field and Gentile AF Depot has time available for additional companies desiring or doing Air Force business. Box 127.

GOVT. PROCUREMENT AND ADMINISTRATIVE CONSULTANT. Wide background and experience includes practice in taxes, accountant with Attorney General of New York and Congressional Committee. Worked with U. S. Dept. of Defense in formulating ASPR, dealing with termination, renegotiation and contract administration. Box 128.

REPRESENTATIVE with a wide following among manufacturers of electronic equipment and government agencies on the Eastern seaboard has an opening for an additional line of quality components. Straight commission basis. Box 129.

FIELD ENGINEER OR MANUFACTURERS LIAISON REPRESENTATIVE: Retired CWO experienced in radar, closed circuit TV. b&w and color and Kinescope recording, data processing and automation, and R & D work. Will relocate with family only. Box 130.

WORKS MANAGER OR CHIEF ENGINEER. Record of managerial competence in integrating engineering, sales and manufacturing. Broad technical background covering several engineering fields such as missile ground support equipment and instruments, solid related manufacturing experience, top sales contacts for military R & D and production work. Box 131.

Positions Available

Industry, government and military agencies are invited to use this column to announce available positions which may be of interest to the readers of SIGNAL. Notices will be published three times if not cancelled before. Applicants apply as indicated in individual notices.

U.S. CIVIL SERVICE COMMISSION. Vacancies now exist for Electronic Technician positions in the Civil Aeronautics Administration in Alaska. Starting salaries are $4,080 and $4,525. No written test required. Full information on how to apply may be obtained at many post offices throughout the country or from the U.S. Civil Service Commission, Washington 25, D. C.

U.S. CIVIL SERVICE COMMISSION has announced vacancies for communications cryptographic coding clerks at $3,415 a year. Applicants must have general experience as a clerk, typist, teletypist or telegrapher, plus 6 months of specialized experience in enciphering and deciphering messages, involving the use of a variety of current cryptographic systems and devices. Radio broadcast technician positions are also available in the International Broadcasting Service at $5,915 a year. No written tests required. Further information and application forms from the U.S. Civil Service Commission, Washington 25, D. C.

ELECTRONIC ENGINEERS. Starting salaries $5,335 and $6,115. Electronic Technicians, salaries from $3,670 to $5,440. Vacancies now exist at the Electronics Division of the New York Naval Shipyard, located at Navy and Sands Streets, Brooklyn 1, N. Y. The shipyard is engaged in activities ashore and afloat, including construction of new super-carriers. Direct inquiries to the Industrial Relations Officer, Telephone Main 5-4500, Extension 2877, 2379 or 2593.

(*Continued on page* 78)

Tracer gas is sprayed over the relay enclosure while it is under high vacuum

STANDARDS THAT DETERMINE RELAY QUALITY

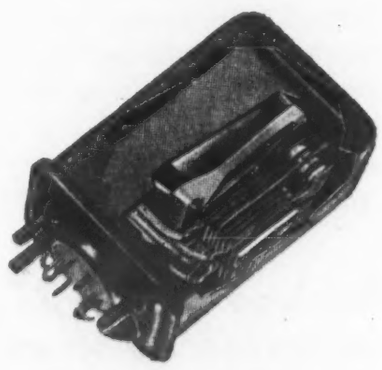
100% leak-free hermetic sealing

We reject relays with leaks so tiny that it would take 30 years to admit 1 cubic centimeter of air!

Hermetically sealed relays are safe from the dangers of human tampering, and from severe conditions of dust and dirt, sand, moisture and high humidity, fungi, salt spray and reduced air pressure. To insure this safety, however, sealed relays must be absolutely free from leaks.

That is why, at Automatic Electric, every single hermetically sealed relay undergoes a sensitive mass spectrometer test. This highly refined method of testing detects leaks so tiny that it would take *more than 30 years for one cubic centimeter of air to pass through!* To protect you, we reject "leakers" able to pass ordinary immersion tests with ease.

Thanks to uncommon care like this at every step of manufacture, Automatic Electric relays are the most reliable you can buy.



Hermetically sealed relays are available in many varieties. Write today for Catalog 4083 PD. Automatic Electric Sales Corporation, Northlake, Ill.
In Canada: *Automatic Electric Sales (Canada) Ltd., Toronto. Offices in principal cities.*

AUTOMATIC ELECTRIC

A member of the General Telephone System
One of America's great communications systems

NEW PRODUCTS FROM INDUSTRY

Electrochemical integrator

Believed to be a scientific breakthrough, the development of an air navigation control device which operates in an iodine solution on very low electrical current and which features great reduction in size, weight and cost, has been disclosed by the U.S. Naval Ordnance Laboratory of Silver Spring, Md.

Designated the "electrochemical integrator," the unit contains an "inertia" principle of operation which, after initially put in motion in one direction, will detect any subsequent change of course effected by atmospheric or mechanical difficulties.

Initial movement of the plane results in chemical changes inside the integrator which produce electrical current. Any change in this movement causes a measureable difference in current output. The current produced operates recorders which reveal amount of change and specific direction.

Operating on very low battery current, no electrical generating gear is required. Additional advantages of the unit are said to be reliability, long life, simplicity of operation and ease of manufacture.

New Amco Blowers

Amco Engineering Co., 7333 W. Ainslie St., Chicago 31, Ill., has developed two new blowers to provide a maximum delivery of filtered air while utilizing a minimum of panel height.

Designed for use in Amco's Modular Instrument enclosure system, the two models, designated B350 and B800, deliver 350 and 800 cubic feet of air per minute, respectively. Each is adequately filtered and fused.

A space saving feature is demonstrated with Model B350 which absorbs only 3½" of the vertical panel space in a standard Amco Modular frame.

Mechanized Microtome For Neuropsychiatric Research

The Leonard Hill Technical Group, 9 Eden St., London, England, has recently publicized a noteworthy advance which was achieved by a novel use of a servo-control speed drive. Now fully-motorized, the microtome was previously a manually-operated device used for cutting a vast number of undistorted sections of the brain at thicknesses varying between 0.001 and 0.0001 inch.

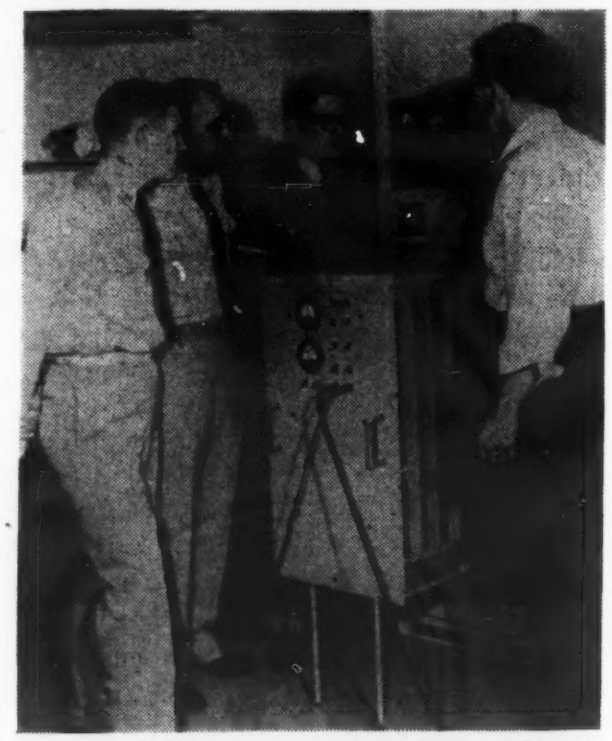
Believed to indicate a wide scope for mechanization in neurological research, the Spencer rotary microtome is equipped with a knife and cutting facets accurate to within one twenty-five-millionth of an inch. A counting mechanism can stop the microtome at any pre-determined figure up to 10,000.

Since preparation of serial sections of 25 human brains requires ½ million slides, the facility with which the technician may work in the orientation of sections within a series, with number and thickness of a section instantly available, is considered a highly advantageous feature in the use of the new microtome.

"Trak" Morse-to-Teleprinter Code Converter

A new 300 word-per-minute Morse-to-Teleprinter Code Converter has been developed by CGS Laboratories, Inc., 391 Ludlow St., Stamford, Conn.

Accepting Morse Code either as tone or keyed dc, the new system, Model CMP-13, operates a page printer, high-speed punch, and a recorder. By releasing 4 fasteners and a cable plug, the conversion matrix may be removed and replaced by another matrix for different conversions.



Army and Navy representatives see Morse code copied automatically at 300 words per minute at CGS Laboratories, Inc., Stamford, Conn. Left to right: Lt. T. Y. Dunn, U.S. Navy; Capt. G. V. Vaughn and Major W. S. Bell, U.S. Army and T. J. Waldron, CGS Laboratories.

Now in design is an improved transistorized model which will occupy only 10½" of panel space.

Of further interest are the CGS reports, entitled "Increductor Notes," which contain data relative to new progress and development in the use of high-frequency electrically-controllable inductors. Reports are available upon request.

Ultrasonic Drill

Powered by high-frequency sound waves, a new drill for boring a precise microscopic hole in very hard ferrite materials has been developed by Lockheed Missile Systems, of Sunnyvale, Calif.

When diamond-hard ferrites are made into magnetic memory cores for electronic computers and data storage devices, the face of each tiny ring-shaped core measures only 45 thousandths of an inch. Consequently, the drilled holes necessary for threading fine coil wires must be only slightly larger than a human hair.

Operating the "silent" drill with a jack-hammer type of action, the ultrasonic frequency put out by an oscillator is of 28,000 cycles per second, which is amplified to provide the current driving the drill. A magnetostrictive effect is gained by the rapid cycling of the frequency.

Pocket-Size TV Camera

For military airborne, mobile, and field closed-circuit TV applications, a new miniaturized TV camera has been developed by Radio Corporation of America, New York, N. Y.

Small enough to be operated in the palm of the hand, the new camera was made possible through the use of transistors, a specially developed transistor circuitry, and a new RCA ½" vidicon camera tube.

Weighing less than a pound, the camera measures only 1⅞ x 2⅜ x 4½ inches.

High-Frequency Crystal Filter

Claimed to play a major role in bringing about dependable world-wide communications, a new radio-radar device developed by Hycon Mfg. Co., 1030 Arroyo Pkwy., Pasadena, Calif., and known as a "high-frequency crystal filter," is said to simplify electronic equipment and to make possible more radio stations for transmitting without overlapping or interfering with one another.

Radio receivers with crystal filters

(*Continued on page 77*)

Progress Report on New Computer Developments

Now General Electric Offers You Complete Computer Machine Time and Computer Services

AT YOUR SERVICE: AN EXPERIENCED STAFF AND THE NEWEST COMPUTER

Immediate assistance in the form of a complete range of General Electric computer services is now available to business, industry and government. Facilities include an IBM 704 Computer having high-speed, random-access core storage of 8192 words, magnetic drums, and ten magnetic tape units. The peripheral equipment provides for complete flexibility in selecting the input and output media.

A staff of 70 specialists which includes leaders in the computer applications field can provide immediate assistance in solving your problems. In addition to supplying the most versatile programming services, the staff is eminently qualified to perform advanced work in the following: *Mathematical Analysis . . . Operations Analysis . . . Simulation*

These are resources with which you can supplement the capabilities of your present staff and facilities.

1 | 2 | 3

The three basic areas of General Electric's Computer Service:

1. COMPUTATION SERVICE

G.E. supplements your present computing capabilities by handling problem overflow resulting from the fact that your own computer time and personnel are scheduled far in advance.

2. DATA PROCESSING SERVICE

G.E. provides complete data processing service, including the submission of interpretive reports to fulfill your exact requirements. Machine time is now available for either single or recurring tasks.

3. REQUIREMENTS EVALUATION

G.E. can evaluate your requirements for data processing and assist you in selecting the correct computer for the task. In addition G.E. will coordinate the installation, develop the program and train personnel to operate the computer.

For complete information contact: General Electric Company, Computer Department, Marketing Section, 1103 North Central Avenue, Phoenix, Arizona.

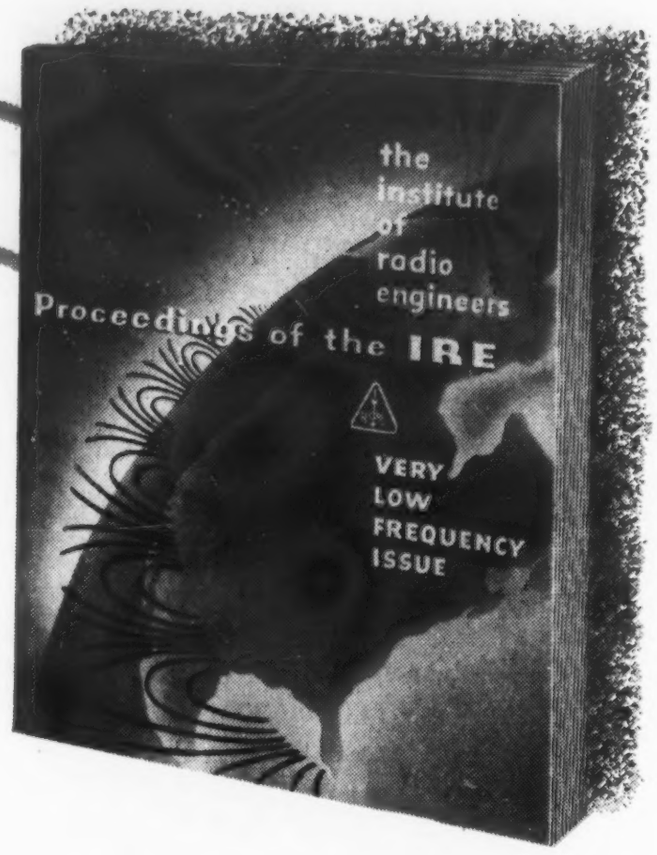
Progress Is Our Most Important Product

GENERAL ELECTRIC

CPA-2 (6-57)

NEWS

ABOUT VERY LOW FREQUENCY PROPAGATION!



Smaller antennas, lower transmitter power, and relative freedom from atmospheric noise are reasons behind our communication services' gradual migration to the upper end of the frequency spectrum. Lying fallow and awaiting rediscovery has been the very low frequency band below 30 kc.

Now, because VLF offers a reliable means of communicating over vast global distances, there is a marked revival of interest. It is now known that VLF has highly stable propagation characteristics which make it possible to transmit data to distant points with unusual fidelity and precision. Where greater accuracy is required, such as very long range radio navigation systems and international transmission of frequency standards, VLF promises to open doors to many new and important uses.

June Proceedings of the IRE gives you the facts about VLF

This year, the Boulder Laboratories of the National Bureau of Standards and the IRE Professional Group on Antennas and Propagation co-sponsored a Symposium at Boulder, Colorado, on the propagation of very low frequency radio waves. From the papers given at this important meeting the editors of *Proceedings* have chosen those of broadest interest for publication in the June, 1957, issue.

Typical of the service offered members of IRE is this VLF report — to be used now and referred to for years to come. If you are not a member of *The Institute of Radio Engineers* be sure to reserve a copy of the June *Proceedings of the IRE*, today!

Partial Contents of this VLF issue:

"A Technique for the Rapid Analysis of Whistlers," by J. K. Grierson, Defense Reserve Board, Ottawa, Ontario, Canada.

"VLF Radiation from Lightning Strokes," by E. L. Hill, School of Physics, University of Minnesota.

"Some Recent Measurements of Atmospheric Noise in Canada," by C. A. McKerrow, Defense Reserve Board, Ottawa, Ontario, Canada.

"Intercontinental Frequency Comparison by Very Low Frequency Radio Transmission," by J. A. Pierce, Croft Laboratory, Harvard.

"The Mode Theory of VLF Ionospheric Propagation for Finite Ground Conductivity," by James R. Wait, National Bureau of Standards, Boulder, Colorado.

"The Geometrical Optics of VLF Sky Wave Propagation," by J. R. Wait & A. Murphy, National Bureau of Standards, Boulder, Colorado.

"Characteristics of Atmospheric Noise from 1 to 100 Kc/s," by A. D. Watt & E. L. Maxwell, National Bureau of Standards, Boulder, Colorado.

"The Present State of Knowledge Concerning the Lower Ionosphere," by A. H. Waynick, The Pennsylvania State University.

"Noise Investigation at VLF by the National Bureau of Standards," by W. Q. Crichlow, National Bureau of Standards, Boulder, Colorado.

"Reflection at a Shapely-Bounded Ionosphere," by I. W. Yebroff, Stanford University.

"The Attenuation Versus Frequency Characteristics of VLF Radio Waves," by J. R. Wait, National Bureau of Standards, Boulder, Colorado.

"The Waveguide Mode Theory of the Propagation of VLF Radio Waves," by K. G. Budden, University of Cambridge, England.

PROCEEDINGS OF THE IRE
1 East 79th Street, New York 21, New York

☐ Enclosed is $3.00
☐ Enclosed is company purchase order for the June, 1957, issue on VERY LOW FREQUENCY.

Name .....
Company .....
Address .....
City & State.....

All IRE members will receive this June issue as usual. Extra copies to members, $1.25 each (only one to a member).

The Institute of Radio Engineers
1 East 79th Street New York 21, New York

do not normally have to be aligned, once manufactured. Quartz filters, each about ½ the size of a dime, are extremely stable despite severe environmental conditions or change, it is said.

Use of crystal filters in the circuit eliminates need for multiple conversion; thus fewer parts are required in the radio or radar receivers.

Primary applications will be in mobile communications equipment. Others include a tiny button microphone, worn on the lapel, which transmits messages several hundred yards without connecting power sources.

"Spacistor"

The "Spacistor," claimed to represent a scientific breakthrough with vast potential in the electronics field and said to combine many of the best properties of the vacuum tube and the transistor, has been developed by Raytheon Manufacturing Co., Waltham, Massachusetts.

The semiconductor device is as tiny as a transistor and operates electrically like a vacuum tube. However, the high temperature Spacistor can be made from materials unsuited for transistors and is expected to operate reliably at 500°C. It is predicted that the Spacistor will amplify at frequencies up to 10,000 megacycles—50 times higher than transistors.

Among electronic equipment expected to benefit materially from the device are guided missiles and rockets, radar and communications equipment, and TV sets.

Claiming other advantages similar to the transistor, the Spacistor operates on a fraction of vacuum tube power, has no filament to heat or burn out, and can be packaged in minute assemblies.

Electronic "Tracks" for Transatlantic Air Traffic

"Dectra," a long-range navigation system designed to provide for the pilot a precise electronic navigational display covering a range of 2300 miles, is now being manufactured by Bendix Aviation Corporation, Pacific Div., N. Hollywood, Calif.

Used in operation with Decca, a similar shorter-range system, the two systems will automatically plot the exact course of either plane or ship. Combined, they weigh 97 lbs.

Pairs of "master" and "slave" sending stations transmit wave patterns occupying specifically known and stable geographical positions, and thus form accurate position lines or "electronic highways." These are picked up by receivers in the aircraft. The position information is then automatically computed and displayed on a "highway map," a navigation chart mounted in the cockpit. A moving pen tracks the position of the plane.

Although traffic control systems require a lateral separation of 120 miles between planes, this system reduces the space to 30 miles or less. With the advent of jet transatlantic airliners, it is believed the system will be of extreme value.

Lightweight Traveling-Wave Tube

A new traveling-wave tube, developed for use in microwave relay and radar equipment by Radio Corporation of America, is said to offer drastic reduction of weight and substantial increase in operating reliability as compared to many present types of traveling-wave tubes.

The compact electrostatic focusing element built into the tube and given a permanent proper alignment during assembly, eliminates the need for bulky external magnetic focusing equipment. Complete with focusing element, the new "plug-in" tube weighs less than a pound.

Although employed thus far as a microwave amplifier, it is believed the new tube promises application in airborne-radar and counter measures equipment as well.

New Humidity Test Chamber

Claimed to provide unsurpassed quality, reliability and appearance, the new humidity test chamber recently developed by Environmental Equipment Co., 369 Linden St., Brooklyn 27, N. Y., also features all-automatic recording, controlling and programming.

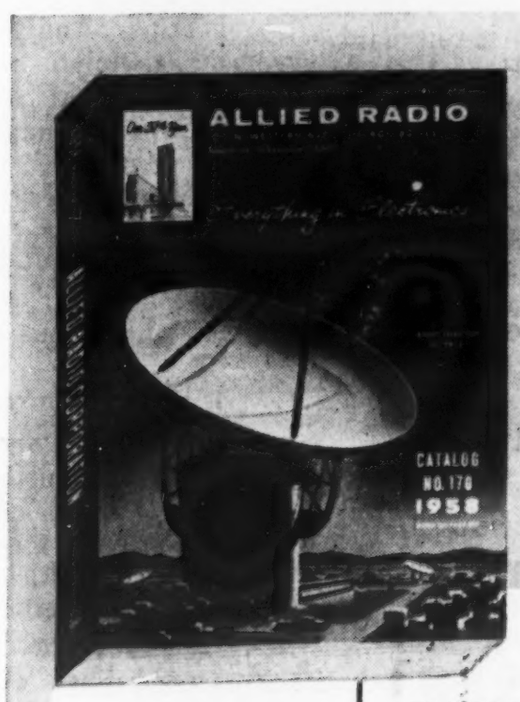
Control tolerance maintained is said to be better than ±2°F., simulating environmental conditions over the temperature range of 0°F. to +200°F., and the relative humidity range of 5% to 98%.

Controls include a 12" diameter wet/dry bulb recorder, controller and programmer.

Having a test volume of 8 cubic ft., Model H8 measures 30 x 20 x 24 inches. Low air velocities are maintained throughout the test space.

TV Microscope

Designated the "ultraviolet, color-translating television microscope," a new instrument which combines techniques of color TV and ultraviolet microscopy for staining cells electronically has been developed at Rocke-



FREE! send for the most widely used
ELECTRONIC SUPPLY GUIDE

ALLIED'S
COMPLETE 404-PAGE
1958 CATALOG

your best buying guide to the world's largest stocks of
ELECTRONIC SUPPLIES FOR INDUSTRY

- Receiving Tubes
- Power & Gas Tubes
- Diodes & Transistors
- Test Instruments
- Meters & Supplies
- Relays & Switches
- AN Connectors
- Metal Chassis Bases
- KNIGHT Public Address Equipt.

Manufacturers' prices available on quantity purchases

our 37th year

Simplify and speed your purchasing of electronic supplies and equipment: send your orders to us for fast shipment from the world's largest stocks of electron tubes (all types and makes), transistors, test instruments (see our money-saving KNIGHT-KITS), audio equipment and electronic parts. Our expert Industrial supply service saves you time, money and effort. Send today for your FREE 1958 ALLIED Catalog—your *complete* Buying Guide to quality Electronic Supplies for Industrial and Communications use.

ALLIED RADIO
100 N. Western Ave., Dept. 97-J7
Chicago 80, Illinois

Send for FREE catalog

feller Institute for Medical Research, New York, N. Y.

Permitting study of living cells without disturbing their motion and development as do radioactive and fluorescent particles, the microscope can be used to trace distribution, utilization and metabolism of specific materials within living cells with an accuracy claimed to be previously unavailable.

New Literature

Printed Circuitry Booklet

The dry screen process is believed to represent an important step forward in solving the knotty problem plaguing electronics manufacturers of reconciling high quality, high volume and low unit cost in the production of printed circuitry.

Providing information on this recently developed process, a new booklet entitled "Superior Printed Circuitry" is now available, free of charge by writing a request on company letterhead, to Dry Screen Process, Inc., 1016 Madison Ave., Pittsburgh 12, Pa.

Unified background data, assembled from many earlier proven installations, also provides research engineers with a description of a fast proven method used to perform work later to be accomplished on a production basis.

Reliability Design Handbook

Supplying information on new materials, processes and techniques, as well as design aids and reliability concepts, the Navy Electronics Lab.'s "Reliability Design Handbook," designated PB 121839, may be obtained from OTS, U. S. Dept. of Commerce, Washington 25, D. C., at $3.00 a copy.

Intended to coordinate data on almost all subjects related to reliability or preferred circuitry in electronics, the handbook assembles in large part material contributed by NEL's engineers, scientists and mechanics.

Beginning in October, quarterly supplements will be distributed by OTS on a subscription basis at $2.25 a year ($3.00 foreign).

X-Ray Inspection Bulletin

Detailing methods used for automatic X-ray inspection of subminiature electron tubes, a new bulletin issued by the Instruments Division, Philips Electronics, Inc., of Mount Vernon, New York, is now available free of charge.

Description is offered of the mass quantity inspection of components for missiles and aircraft systems, and of the X-ray work which involves welds on wire stock measuring .003 to .015 inch in diameter.

Use of this new technique permits the daily check of 18,000 tubes and the inspection involves lead, glass. nickel, barium, aluminum, iron and other materials which exist in alloys and chemicals of subminiature tubes.

Personnel Clearing House

(*Continued from page* 72)

ELECTRONIC ENGINEERS (up to $7570 per year) are needed by the Civil Aeronautics Administration to apply latest knowledge of electronics to air traffic control, telecommunications and navigational aids. Individual engineer positions concerned with the design, procurement and specifications, factory inspection, installation, calibration and maintenance of ground and airborne electronic equipment. Equipment includes radar, distance aids, VHF radio transmitters and receivers and radio and land line telecommunications. Employee benefits: paid vacations, sick leave, insurance and retirement programs. Write Civil Aeronautics Administration, Personnel Division (W-91.3), T-5 Bldg., 17th & Constitution Ave., N.W., Washington 25, D. C.

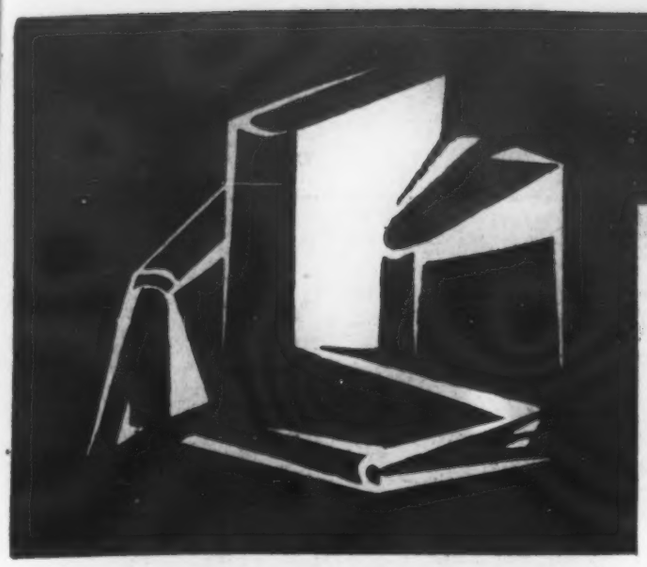
U. S. ARMY ELECTRONIC PROVING GROUND
FORT HUACHUCA, ARIZONA

2	Supv. Electronic Engineer	GS-855-14	General
1	Military Intelligence Analyst	GS-134-9	
1	Contract Specialist	GS-1102-12	
1	Meteorologist	GS-1340-12	General
1	Meteorologist	GS-1340-11	General
1	Engineer	GS-801-11	General
1	Engineer	GS-801-9	General
1	Wildlife Manager	GS-485-9	
1	Electronic Engineer	GS-855-13	General
1	Electronic Engineer	GS-855-13	Radio
1	Electronic Engineer	GS-855-13	Instrumentation
1	Electronic Engineer	GS-855-13	
1	Supv. Electronic Engineer	GS-855-12	Instrumentation
1	Supv. Electronic Engineer	GS-855-12	General
1	Electronic Engineer	GS-855-12	General
3	Electronic Engineer	GS-855-12	Wire Communication
2	Electronic Engineer	GS-855-12	Radio
1	Electronic Engineer	GS-855-12	
1	Electronic Engineer	GS-855-11	Wire Communication
1	Electronic Engineer	GS-855-11	General
3	Electronic Engineer	GS-855-11	Radio
1	Supervisory Elct. Technician	GS-1671-12	General
1	Electronic Technician	GS-1671-9	Instrumentation
3	Electronic Technician	GS-1671-9	
1	Electronic Scientist (Supv.)	GS-1312-12	General
1	Electronic Scientist	GS-1312-11	Radio
1	Psychologist	GS-180-11	
2	Mathematician	GS-1520-13	
2	Mathematician	GS-1520-11	
1	Supv. Analytical Statistician	GS-1530-12	Engineering
1	Analytical Statistician	GS-1530-9	Engineering
1	Supv. Management Analyst	GS-303-12	
1	Management Analyst	GS-303-11	
1	Management Analyst	GS-303-9	
1	Supv. Physicist	GS-1310-13	General
2	Publications Editor	GS-010-9	Phys. Sciences & Engr.
1	Publications Writer	GS-010-9	Phys. Sciences & Engr.

SCENARIO WRITER ($7570 per year). Six years of progressively responsible and successful experience in writing scenarios, script, dialogue for motion pictures or related fields. Experience must include three years in field of motion pictures. Substitution of education for experience: successful completion of study in college or university may be substituted for not more than 3 years of the required experience on the basis of one year of education for each 9 months of experience. No educational substitution will be allowed for experience in the field of motion pictures. Grade GS-1071-12. Army Pictorial Center, Long Island City 1, N. Y.

TELETYPE OPERATORS, COASTAL STATION RADIO OPERATORS. International communications company. Liberal company benefits. Submit resume with name, address, age, past experience—if any, military experience—if any, FCC Second Class Radiotelegraph license required for Coastal Station Radio Operator. Write to Asst. Director of Personnel, RCA Communications, Inc., 66 Broad Street, New York 4, N. Y.

PACKAGING AND PRESERVATION SPECIALISTS GS-7 and 9 ($4525 to $6250 per year) are needed by the Philadelphia U.S. Army Signal Supply Agency to develop and write specifications for preservation, packaging, packing and marking of Signal Corps equipment. Submit resume and the Armed Forces Communications and Electronics Association will forward same immediately to employer who will acknowledge your application direct.



Books

THE WAR POTENTIAL OF NATIONS, by Klaus Knorr. Princeton University Press, Princeton, N. J. 310 pages, $5.00.

Klaus Knorr, of the Center of International Studies at Princeton, copes with 2 problematic issues in this pioneering treatise: What is the true concept of "war potential?" and, is it, as distinguished from mobilized strength, important in a world where total nuclear war can annihilate an enemy in a matter of days?

Rather than confining his study to one of "economic" or "industrial" potential, the author interrelates all other elements he believes constitute the latent strength of nations. Specifically, Professor Knorr is equally concerned with a government administration so effective that it allows no situation to be unforeseen or insurmountable, and with the morale components of a population so well motivated by government-fed mass media of communication that it has "the will to fight."

To illustrate and buttress his economic concepts, Professor Knorr cites many interesting historical accounts of economic mismanagement and strangulation.

Combining the methods and the researches of political scientists, sociologists, psychologists, historians and economists, the study nevertheless has been directed in its presentation to the non-specialist reader.

FROM THE GROUND UP, by Sandy S. F. MacDonald. Aviation Service Corp., Ltd., Port Credit, Ontario. 156 pages, 256 illustrations, paper bound, $5.00.

A complete coverage of material required in preparation for private or commercial pilot examinations is available in this newly-revised aviation training manual.

Offering solution and analysis of 193 typical examination questions, the handbook, however, does not cover instrument flying requirements for public transport pilot's license.

Timely additions to this tenth edition include Controlled VFR, Decca, Radar Advisory Service, the astro compass, new VHF radio equipment, omni and ADF, hazards of tip vortex, the by-pass gas turbine engine, new ADIZ rules and regulations, and "busy" signal at radio beacon stations.

ATOMS AND ENERGY, by Professor H. S. W. Massey. Philosophical Library Inc., New York. 174 pages, $4.75.

The potential of a hydrogen bomb, already highly publicized by newspapers, is an example of the immensity of the new power now available for war or for peace as a result of the development in atomic physics.

Analyzing those events in atomic research development which led to the large-scale release of atomic energy, Professor Massey presents this, his central theme, with concern for the non-scientific reader. Technical aspects of the development are eliminated from his discussion, but, it is believed, with no sacrifice of accuracy.

Included in the study is a chapter discussing the applications of atomic energy for medical and industrial purposes along with its destructive possibilities. Among the many interesting descriptions included in Professor Massey's study is the explanation of the conversion of atomic energy into heat in the sun and stars.

A final chapter focuses attention on present-day research.

SPHEROIDAL WAVE FUNCTIONS, by Dr. Carson Flammer. Stanford University Press, Stanford, Calif. 220 pages, $8.50.

The importance of spheroidal wave functions in the mathematical solution of many problems—both in acoustics and electromagnetic wave theory, and in atomic and nuclear physics—accounts for the prominent place which this up-to-date monograph is expected to fill as an essential reference tool for mathematical physicists, mathematical engineers and applied mathematicians.

Authored by the senior mathematical physicist in the Engineering Division of the Stanford Research Institute, the treatise presents a historical survey of the development of the functions together with an account of the many diverse physical problems to which the functions have been applied.

Coverage of the theoretical properties is claimed to be more nearly complete than any previous work in the field. As an aid in the use and calculation of spheroidal wave functions, tables and detailed accounts of the function properties are included.

GUIDED WEAPONS, by Eric Burgess. The Macmillan Co., New York 11, N. Y. 255 pages, $5.00.

Whether or not the concept of the deterrent power of technological weapons of mass destruction is sound, we are coming to regard science as synonymous with salvation. A rocket capable of vast destruction, continents away from its launching site, is no longer a fantasy, for it has been demonstrated that long-range guided weapons can be a part of a nation's armory.

For layman or engineer interested in this timely subject, this book provides essential details of every type of missile, both in production and in the planning. Classifying each type of missile according to use, the author treats the various categories separately, centering his discussion on specific technical features such as the guidance system, the power plant, the propellant, and lethal effectiveness. Explanations are simplified but accurate.

The dramatic account of missile development since the time Germany first used them against Allied shipping in WW II, the penetration into the dilemma of maintaining a balanced economy while creating a national defense system based upon guided weapons, and the exploration of future achievements in missile production—all should make the reading of Mr. Burgess's book an exciting adventure and a rewarding experience.

RETIREMENT FROM THE ARMED FORCES, by A Committee of Retired Army, Navy and Air Force Officers. The Military Service Publishing Co., Harrisburg, Pa. 431 pages, $4.95.

The increasing span of human life and the lowering retirement age for Armed Forces personnel has given an ever-growing importance to the need for consideration of the problems encountered in the transition from Service life to retirement.

Enlivened by a considerable amount of humor and informal discussion, the book presents an account of experiences and advice assembled from investigations of several thousand retired officers.

Treatment of numerous topics closely related to retirement is based on the advice of experts in those respective fields. Completely cross-referenced and indexed, the work includes reference data concerning: a new position; savings and investments; advice for the widow; V.A. benefits and Social Security; Service benefit restrictions; pay, allotments, taxes and claims, and means for setting up in business.

AFCEA Insignia

$1.50

Membership Certificate
Ideal for Home or Office

AFCEA Official Medal
(A.R. 600-70, para. 33e)
Bronze: **$3.00** Silver: **$4.00**
Gold: **$5.00**

Lapel Button
For Civilian Dress
Bronze: **$1.50** Sterling: **$2.50**
Gold: **$5.00**
(Prices include tax)

3" Dia. Decalcomania
Can be transferred to glass or any smooth solid surface
4 for **$1.00**

Illustrations are not drawn to scale.

All Insignia may be ordered from:
AFCEA Service Dept.
1624 Eye Street, NW
Washington 6, D. C.

National Advertising Representatives
William C. Copp & Associates
72 West 45th St., New York 36, N. Y. Murray Hill 2-6606
35 E. Wacker Dr., Chicago 1, Ill. STate 2-5795

INDEX TO ADVERTISERS

Admiral Corp.
Cruttenden & Eger Associates 41
Allied Radio Corp.
George Brodsky Advertising, Inc. 77
American Telephone & Telegraph Co.
N. W. Ayer & Son, Inc. 1
Arnold Engineering Co.
W. S. Walker Advertising, Inc. 61
Atlas Precision Products Co.
A. E. Aldridge Associates 51
Automatic Electric Co.
Proebsting, Taylor Inc. 73
Bendix Aviation Corp., Eclipse-Pioneer Division
MacManus, John & Adams, Inc. 59
Bendix Aviation Corp., Radio Division
MacManus, John & Adams, Inc. 32
Bruno-New York Industries Corp.
Jaman Advertising, Inc. 67
Burroughs Corp.
Campbell-Ewald Co. 37
Capitol Radio Engineering Institute
Henry J. Kaufman & Associates 57
Contraves Italiana
..... 64
Ford Instrument Co.
C. M. Basford Co. 69
General Electric Co., Computer Dept.
The McCarty Co. 75
General Electric Co., Light Military Electronic Equipment Dept.
De Garmo, Inc. 20
General Mills, Inc., Mechanical Division
Knox Reeves Advertising, Inc. 35
General Radio Co.
K. E. Morang Co. ..... 3rd Cover
The Hallicrafters Co.
Henry B. Kreer & Co. 63
Hoffman Laboratories, Inc.
Dan B. Miner Co., Inc. 14, 15
Hughey & Phillips, Inc.
Welsh & Hollander Advertising 13
Hunter Manufacturing Co.
Meermans, Inc. 70
Institute of Radio Engineers
Raymond Schoonover Advertising 76
International Resistance Co.
Arndt, Preston, Chapin, Lamb & Keen, Inc. 4
Lenkurt Electric Co.
Boland Associates 2
J. M. Loge Sound Engineers
Bill West Advertising 34
Glenn L. Martin Co., Inc.
VanSant, Dugdale & Co., Inc. 6
Motorola, Inc.
Kolb & Abraham Advertising 9
Nems-Clarke, Inc.
Admasters Advertising, Inc. 66
Radio Corporation of America, Defense Electronic Products
Al Paul Lefton Co., Inc. 49
Radio Engineering Products
..... 40
Raytheon Manufacturing Co.
Donahue & Coe, Inc. ..... 4th Cover
Sangamo Electric Co.
Arthur R. Mogge, Inc. 71
Sperry Gyroscope Co.
Reach, Yates & Mattoon Advertising, Inc. 44
Stromberg-Carlson Co.
Charles L. Rumrill & Co., Inc. 47
Times Facsimile Corp.
Thomas & Douglas, Inc. 23
Tower Construction Co.
Amundson, Bolstein Advertising, Inc. 68
Tung-Sol Electric, Inc.
E. M. Freystadt Associates, Inc. 72
United Transformer Corp.
Shappe-Wilkes, Inc. ..... 2nd Cover

APPLICATION FOR INDIVIDUAL MEMBERSHIP

ARMED FORCES COMMUNICATIONS AND ELECTRONICS ASSOCIATION
1624 Eye Street, N. W. Washington 6, D. C.

NAME: ..... (Last Name) (First Name) (Middle Name or Initial)

Mail ☐

Home Address: ..... ☐

Business Address: ..... ☐

Name of Firm or Military Installation: .....

Title: ..... Type of Work: .....

Type of Membership desired: Full — $5.00 ☐ Student — $2.50 ☐ Life — $50.00 ☐

I am a citizen of the U.S.A. ..... ☐ Foreign Associate — $5.00 ☐

I am a citizen of ..... ☐

Enclosed find $..... for annual dues for AFCEA membership, which includes subscription to the monthly magazine, SIGNAL.

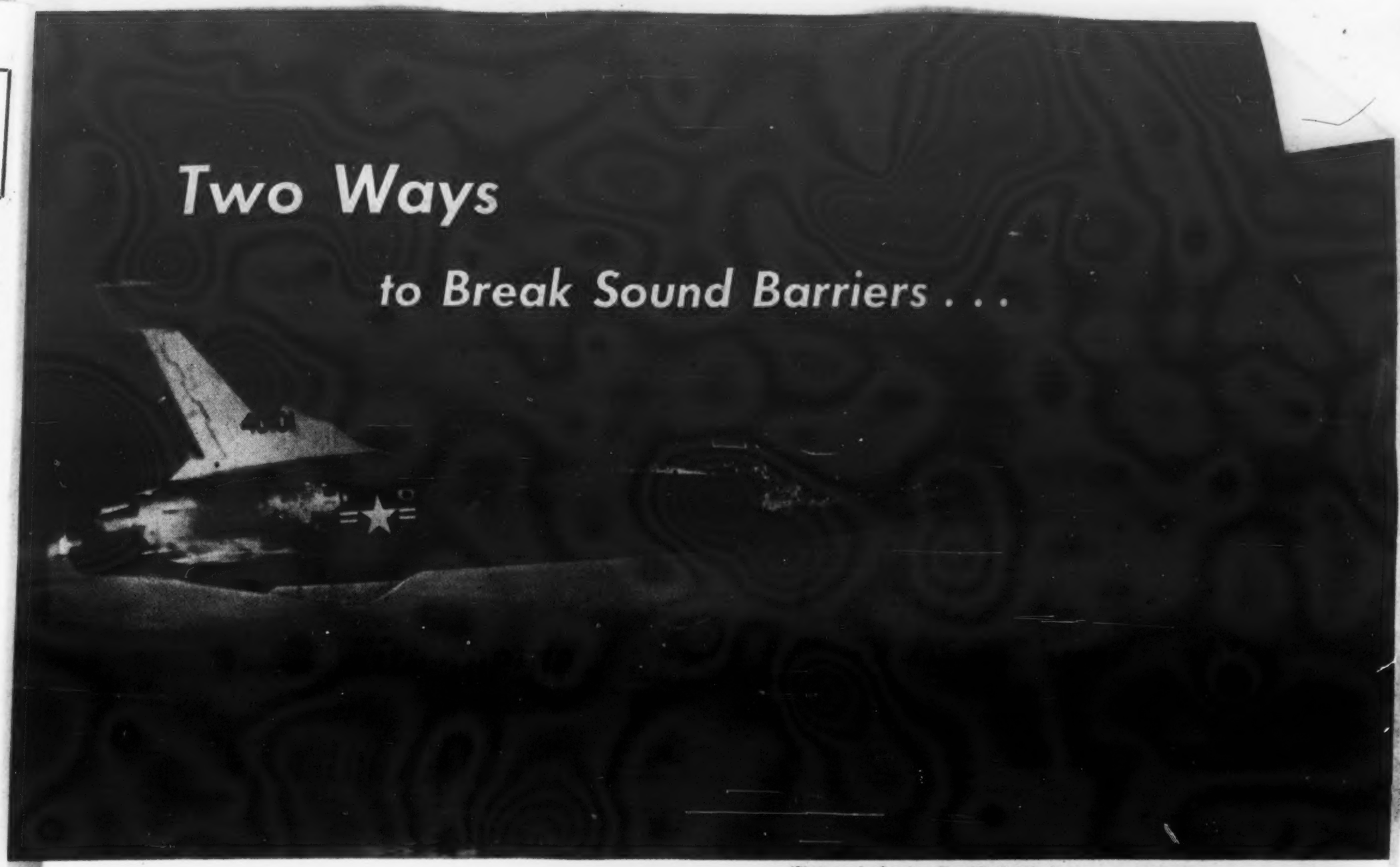
DATE: ..... SIGNATURE: .....

(PLEASE TYPE OR PRINT)

..... 41
..... 77
..... 1
..... 61
..... 51
..... 73
..... 59
..... 32
..... 67
... 37
... 57
... 64
.. 69
.. 75
. 20
. 35
Cover
63
, 15
13
70
76
4
2
34
6
9
66
49
40
er
1
4
7

Two Ways

to Break Sound Barriers . . .



(Photographs Courtesy Republic Aviation)

This G-R System is a fully-integrated line of instruments for the accurate measurement and analysis of both sound and vibration. Research engineers at Republic Aviation broke another sound barrier by putting the G-R Sound-Measuring System to use in their investigations of the effects of gunfire concussions on an airborne radar system. Physical shock to electronic components caused by gunfire becomes a problem of major proportions when designing equipment for maximum reliability.

The test procedure began with the calibration of the recording microphone's level — this was accomplished with the General Radio Sound-Level Meter, Transistor Oscillator, and Microphone Calibrator. The data was recorded on tape near the aircraft during gun firing, and was subsequently analyzed with the G-R Octave-Band Analyzer. Improved sound and vibration isolation for the electronic equipment solved this knotty problem for Republic. From start to finish, General Radio equipment furnished the correct answers to this problem.

Calibrating the tape recorder microphone prior to recording. Shown are:

G-R Type 1551-A Sound-Level Meter $385
Type 1551-P1H Condenser Microphone Assembly with preamplifier and power supply $300
Type 1552-B Sound-Level Calibrator $52.50
Type 1307-A Transistor Oscillator $80

The General Radio Sound-Measuring System can help you find the right answers to your sound or vibration problem. For further information, write for the Sound Bulletin, which gives a complete description of G-R sound and vibration instruments.

GENERAL RADIO Company

275 Massachusetts Avenue, Cambridge 39, Mass., U.S.A.

Broad Avenue at Linden, Ridgefield, N. J. **NEW YORK AREA**
8055 13th St., Silver Spring, Md. **WASHINGTON, D. C.**
1182 Los Altos Ave., Los Altos, Calif. **SAN FRANCISCO**
1000 N. Seward St. **LOS ANGELES 38**
1150 York Road, Abington, Pa. **PHILADELPHIA**
6605 W. North Ave., Oak Park, Ill. **CHICAGO**

All G-R Products are now covered by a

2-Year Warranty

AIR UNIVERSITY LIBRA
ACQUISITIONS BRANCH,
MAXWELL AIR FORCE BA
AFL 3302 01-600-57-30

m
surv
transmitt
by Ray
the
I
broad

Excellence in Electronics

RAYTHEON

RAYTHE

LIBRARY
RANCH, SERIALS SECTION
RCE BASE, ALABAMA
-57-3011 C-12-57
7-4

TV RELAY —SUITCASE SIZE

"As revolutionary as gun powder . . ." says a military authority of tactical television, latest communications device of the armed services.

Pictures of amphibious landings, battlefield surveillance and relayed aerial reconnaissance are transmitted instantly to the point of tactical command by Raytheon's KTR microwave relay. Lightweight, compact, rugged and powerful, this unit gets the picture through under toughest conditions.

In civilian life, the KTR relay serves television broadcasters, utilities and common carriers, helps control traffic and keeps an eye on industrial processes. This versatile unit is further evidence of Raytheon's *"Excellence in Electronics"*.

ON

RAYTHEON MANUFACTURING COMPANY
WALTHAM 54, MASSACHUSETTS

October 1957

Moon Radar

See Page 3